WASTE OIL FURNACE EMISSION TESTING

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Northwest Territories Renewable Resources
Pollution Control Division

WASTE OIL FURNACE EMISSION TESTING:

YELLOWKNIFE, HAY RIVER
APRIL 1990

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SUMMARY

Waste oil burner emissions were tested at six locations in Yellowknife and Hay River N.W.T. in April 1990 for particulates, metals, sulfur oxides, nitrogen oxides, hydrocarbon solvents, hydrocarbon gases, combustion gases, halides and polynuclear aromatic hydrocarbons. Samples of feed oil and burner ash from each burner were also analyzed.

Test results indicate the effect of burner operation and maintenance on the amount of pollutants emitted from the burner stacks. Average particulate concentrations ranged from 25 mg/m^3 to 677 mg/m^3. Sulfur dioxide emissions ranged from 267 mg/m^3 to 780 mg/m^3, and nitrogen dioxide levels ranged from 60 mg/m^3 to 161 mg/m^3. Hydrogen chloride emissions were 27 and 29 mg/m^3 respectively at two locations and in the 3-6 mg/m^3 at the other four locations.

To quantify the burner emissions the emissions were compared to B.C. Waste Management Act Special Waste Schedule 2 emission criteria for Thermal Treatment Facilities.

The average particulate concentration of 288 mg/m^3 and the average sulfur dioxide concentration of 521 mg/m^3 exceeded the Schedule 2 emission criteria of 50 mg/m^3 and 250 mg/m^3 respectively. The limits for carbon monoxide, hydrogen chloride, hydrogen fluoride, nitrogen dioxide and total hydrocarbons were not exceeded.

Metal analysis of the particulates indicated that the metal emissions were well under the Class I, II and III Metals limits. Zinc (1.9 mg/m^3) and lead (0.84 mg/m^3) were the highest Class I metals present (limit is 5 mg/m^3). The Class II and III metal emissions were minimal.

The main constituents of the burner ash were phosphorus 13.5%, magnesium 6.0%, calcium 4.0% and zinc 3.8%. The main constituents of the feed oil were phosphorus 918 mg/L, zinc 825 mg/L, magnesium 495 mg/L, calcium 472 mg/L and lead 177 mg/L.

Low levels of hydrocarbon solvents were found in the burner emissions, with toluene (average 1.7 mg/m^3) the most common. One of the burners had a methyl ethyl ketone concentration of 11 mg/m^3.

The PAH levels in the two ash composite samples were minimal (<0.5 µg/g) whereas the levels in the feed oil composite samples were 56 and 90 µg/g respectively.

The burner ash contained 4.6-5.6% total sulfur and 30-33% carbon content. The feed oil sulfur content was 0.5-0.7%.

Although the average particulate and sulfur dioxide concentrations in the burner emissions are quite high, the actual amounts of these pollutants are minimal due to the very low stack flowrates of one - two m^3/min found with the types of burners tested.

STAFF AND ACKNOWLEDGEMENTS

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I INTRODUCTION

In the North West Territories, as in the rest of Canada, the disposal of vaste lubricating oil is becoming a major concern. Present disposal methods such as road dust suppression, open burning and unauthorized dumping are environmentally unacceptable.

In recent years the development of efficient vaste oil burners represents a practical solution to this disposal problem.

In the N.W.T. this vaste oil is a readily available and inexpensive source of energy. Combining the safe destruction of this vaste oil with the generation of heat energy would solve a major problem in an environmentally fragile area.

Nov that several types of vaste oil burners are in use in the N.W.T. a study of these burner emissions at six different locations in Yellovknife and Hay River vas initiated by the Government of the N.W.T. to determine the pollutant concentrations emitted to the atmosphere.

In December of 1989 B.C. Research vas requested to submit a plan to test six burners (emissions) for particulates, sulfur oxides, nitrogen oxides, hydrocarbon solvents, halides, polynuclear aromatic hydrocarbons, combustion gases, hydrocarbon gases and metals. The testing vas carried out in mid-April 1990.

The following table describes the types of burners tested and their location.

TABLE 1

BURNER LOCATION AND DESCRIPTION

TEST NO:	UNIT DESIGNATION	DESCRIPTION NAME	MODEL	BURNER TYPE*	NAMEPLATE HEATING OUTPUT Btu/hr	FUEL INPUT L/hr	STACK DIAMETER Inches
Yellowknife							
1,2	Unit A	Lanair	L220E	Vaporizer	160,000	4.32	8
3,4	Unit B	Lanair	LV-110	Vaporizer	70,000	1.89	6
5	Unit C	Energytech Corp. Econo-heater	3017	Atomizer	-	-	7
Hay River							
6,7	Unit D	Lanair	LV-110	Vaporizer	70,000	1.89	6
8	Unit E	Lanair	LV-110	Vaporizer	70,000	1.89	8
9	Unit F	Lanair	L220E	Vaporizer	160,000	1.14	8

* Atomizing Oil Burner Type: This burner mechanically reduces the oil into a fine mist of very small particles for combustion.

* Vapouring Oil Burner Type: This burner preheats the oil to its vapourizing point, producing an oil vapour of much larger particles for combustion.

The following sections describe the test methods used and the testing results.

II METHODOLOGY

Access to the burner stacks was gained through the stack damper or, in the absence of a damper, by drilling 1/4 - 1/2" holes into the stack. The particulate probe and nozzle and 1/4" probes for the nitrogen oxide and the combustion gas trains were sealed into the damper opening using cloth rags. The sample probes were positioned in the centre of the stacks for the entire tests.

A. STACK EMISSIONS

1. Particulates, sulfur oxides, halides

A modified EPA Method 5 - 8 sampling train was used to obtain samples for particulates, sulfur oxides and halides.

The stack gas was extracted through a heated, glass-lined probe, a filter and then scrubbed in an ice-cooled impinger train. The gaseous chlorides and fluorides were removed from the gas stream in the first two impingers using de-ionized water as the collection medium. The sulfur oxides were collected in the fourth and fifth impingers (third impinger empty), using a 3% hydrogen peroxide solution to convert any sulfur dioxide to the sulphate form. The gas was then dried in a silica gel drying tower and passed through a standard vacuum pump and dry gas meter (sampling console). Following the tests, the particulate filters were dried, desiccated and weighed.

De-ionized water samples from impingers 1 and 2 were analyzed for chloride, fluoride and bromide content by ion chromatography (Dionex Series 4500 Analyzer).

The solutions from impingers 4 and 5 were analyzed for sulphate using the standard barium perchlorate-thorin indicator method. Sulphates were analyzed on aliquots of the de-ionized water samples (impinger 1 + 2) also to ensure that all of the sulfur oxides present in the gas stream were accounted for.

2. Nitrogen Dioxide

The stack emissions were tested for nitrogen oxides using the standard Ministry of Environment ELP-80-04 method. The gas samples were collected by bubbling the stack gas through four impingers containing a 4% potassium permanganate - 2% sodium hydroxide solution, a silica gel tower, a pump and a low flowrate dry gas meter. The second and third impingers were equipped with fritted glass tubes. The fourth impinger was added to ensure complete absorption of all of the nitrogen oxides present. The impinger solutions were analyzed using MOE method No. 8036101. In this method, the nitrate collected by absorption in the $KMnO_4$-NaOH solution is quantitatively reduced to nitrite and determined by diazotizing with a sulphanilamide and coupling with N-(1-nathyl)-ethyle-nidiamine to form an ozc dye which is measured colormetrically at 529 nm.

3. Dry Gas Analysis

Four gas samples per burner were taken by passing the stack gas through a sample train containing a moisture knock-out pot, a drying tower containing Sicapent drying agent, and an air-tight pump. The dried gas was pumped into flushed sample bags (Saran) and later in the week analyzed on a gas chromatograph equipped with a flame ionization detector for hydrocarbon analysis and on a gas chromatograph equipped with a thermo conductivity detector for combustion gas analysis. The stack gas was also analyzed on site using a portable Nova gas analyzer.

4. Trace Metals

After the particulate filters were weighed, the filters and contents were digested in dilute nitric acid, filtered and the solutions analyzed by inductively coupled plasma - mass spectrography (ICP-MS).

5. Hydrocarbon Solvents

Small battery powered pumps and charcoal tubes were used to collect samples for hydrocarbon solvent determinations. The calibrated pumps were used to drav stack gas through the charcoal adsorption tube at a flovrate of approximately 200 ml/min. The tubes were then desorbed using Freon and the solutions analyzed by gas chromatrography (GC-FID).

B. ASH

A sample of the burner ash vas collected after each testing date and analyzed for metals and PAH. The metals were determined by mixed acid digestion and analyzed by ICP-MS. Composite samples of ash from Yellovknife and from Hay River were analyzed for PAH by liquid chromatography. The ash vas refluxed with ethanolic KOH for 1 hour and the filtered solution extracted with iso-octane. The iso-octane fraction was vashed with varm vater, dried, and then cleaned up on a Florisil column. The sample vas then solvent-exchanged to acetonitrile/CH_2Cl_2 and analyzed on a Vaters 600E liquid chromatograph with a variable vavelength UV detector (set at 280 nm) and a Supelcosil LC-PAH column.

The ash composite samples were also analyzed for total sulfur and carbon content using a Leyhaus Carbon-Sulfur Analyzer.

C. WASTE OIL FEED

A sample of feed oil was taken from the burner storage tank or burner reservoir during each test. The oil samples were first fumed off and then the residues digested with hydrochloric acid. The solutions were then analyzed for metals by ICP-MS. Composite samples of waste oil were analyzed for PAH by liquid chromatography. The oil was dissolved in iso-octane, then treated with conc. H_2SO_4. The iso-octane extract was then cleaned up on a Florisil column. The sample was solvent-exchanged to acetonitrile/CH_2Cl_2 and analyzed on a Waters 600E liquid chromatograph with a variable wavelength UV detector (set to 280 nm) and a Supelcosil LC-PAH column.

The six oil samples were also analyzed for total sulfur using a standard wet chemistry method (barium perchlorate titration).

III RESULTS:

The burner emission test results are shown in Tables 2 - 7. A comparison of these results is shown in Table 8.

As shown in Table 2 the burner operation at Unit A was quite steady during the test period, as depicted by the similarity in the results from the two tests. The test isokinetics were greater than 100% +/- 10% because of the malfunction of the sampling train dry gas meter (broken in transit) which necessitated the adaptation of a spare dry gas meter (control unit orifice bypassed) on site. This dry gas meter was correctly installed into the control unit after the first day of testing and the control unit re-calibrated at B C Research after completion of the testing.

The Unit B burner was apparently in poor operating condition on the day of the tests. The inside of the burner stack was coated with black soot and a dark stack plume was initially evident. After Run 1, in which the particulate concentration was very high (947 mg/m^3), the business proprietor was urged to increase the air flow (furnace adjustment) before commencement of the second test. This change in burner operation reduced the particulate emissions by more than 50% to 406 mg/m^3.

Burner operation at the Unit D location (Table 5) was unsteady during the test period as indicated by the particulate levels (Run 6, 105 mg/m^3, Run 7, 15 mg/m^3) and by the moisture levels (Run 6, 4.5%, Run 7, 11.1%).

A comparison of the burner emission tests (Table 8) indicates that the burner emission flowrates were very low (average 1.5 m^3/min) with the highest flowrate measured at Unit F (1.9 m^3/min) and the lowest flowrate at Unit B (1.0 m^3/min). In all six cases the burner exhaust flowrate is a product of the convectional furnace heat and the stack diameter. No fan is used to force the furnace discharge gases up the stack. The particulate emissions ranged from a high of 677 mg/m^3 at Unit B to a low of 25 mg/m^3 at Unit A. Hydrogen chloride emissions were high at Unit A (26.8 mg/m^3) and at Unit F (29.3 mg/m^3) and quite low at the other four locations (3.5 - 5.9 mg/m^3). Hydrogen fluoride and hydrogen bromide levels were minimal at all sites with the highest HF and HBr concentrations at Unit A (3.1 mg/m^3 HF and 2.2 mg/m^3 HBr), respectively. Sulfur dioxide levels were quite high at all six locations (average 521 mg/m^3) with the highest level at Unit C (780 mg/m^3) and the lowest level at Unit E (267 mg/m^3). The nitrogen dioxide levels (average 117 mg/m^3) ranged from 60 mg/m^3 at Unit B to 161 mg/m^3 at Unit A. The total hydrocarbon concentration (as C_6) were approximately 1 ppm at all six sites except for at Unit C (3.1 ppm). Because the stack exhaust flowrates were so low (1.0 - 1.9 m^3/min), a more realistic unit for describing the pollutant concentrations would be grams per hour (g/h). The particulate and sulfur dioxide concentrations have been so identified in Table 8.

The combustion gas analysis for the three Hay River burners was apparently faulty as the gas analysis approximates that of air. The pump used to collect the samples was apparently damaged in transit from Yellowknife to Hay River. The stack flowrate calculations, however, are not significantly affected by the inaccurate combustion gas analysis.

When the test results are compared to the Waste Management Act Schedule 2 Emission Criteria* (Special Waste, Thermal Treatment Facilities), the average particulate (288 mg/m^3) and sulfur dioxide (521 mg/m^3) concentrations are shown to exceed the limits of 50 mg/m^3 and 250 mg/m^3 respectively. The limits for CO, HCl, HF, NO_2 and THC were not exceeded. The limits for emissions from municipal incinerators (Greater Vancouver Regional District) are essentially the same as those in Schedule 2, except for carbon monoxide (57 ppm). Trace metal limits are 25% higher than those listed in Schedule 2 (see Table 9). The federal stack discharge limits for municipal solid waste incinerators and the anticipated emissions from such incinerators have been included in the appendix. The particulate (20 mg/m^3) concentration limit is less than half of the Schedule 2 limit of 50 mg/m^3.

The metal concentrations in the burner emissions are compared with the Class I, II and III* Waste Management Act Special Waste Schedule 2 limits in Table 9. Zinc, copper and lead were the major Class I metals found all six metal concentrations well below the 5 mg/m^3 limit. Chromium and nickel were the highest Class II metals found with all six metal concentrations well under the 5 mg/m^3 limit. The Class III metals were all less than the 0.2 mg/m^3 limit.

Toluene was the most common hydrocarbon solvent in the burner emissions (see Table 10) with an average concentration of 1.3 mg/m^3 found in the six burners with the highest concentration of 7.5 mg/m^3 found in the Unit F burner emissions. Methyl ethyl ketone (average <1.0 mg/m^3), benzene and xylene (<1 mg/m^3) were other measurable hydrocarbon solvents found. The highest individual solvent concentration measured was methyl ethyl ketone (11 mg/m^3); in the Unit F emissions (Run 1). The highest

* British Columbia

toluene (7.5 mg/m^3), xylene (6.3 mg/m^3), and ethylbenzene (1.3 mg/m^3) concentrations were also found in the Unit F burner emissions. The highest acetone (1.9 mg/m^3) and benzene (1.7 mg/m^3) concentrations were found in the Unit A burner emissions.

The burner ash composition is summarized in Table 11. The major metal concentrations were phosphorus (13.5%), magnesium (4.3%), calcium (4.0%), zinc (3.8%) and iron (1.5%). Besides zinc the other Class I metals present were manganese (0.31%), lead (0.73%) and copper (0.24%). The Class II and III metal levels were minimal.

As shown in Table 12 the major metals in the burner feed oil were phosphorus (918 mg/L), zinc (825 mg/L), magnesium (490 mg/L), calcium (472 mg/L), lead (177 mg/L), iron (154 mg/L) and manganese (60 mg/L). These seven metals were found in essentially the same compositional order as in the burner ash analysis.

In Table 13 the sulfur content in the two ash composite samples and in the six feed oil samples from Yellowknife and Hay River is summarized. The sulfur content in the ash was 4.6% and 5.6% respectively while the sulfur in the waste oil ranged from 0.5% to 0.7%.

In Table 14 are shown the polynuclear aromatic hydrocarbon (PAH) concentrations in the feed oil and ash composite samples. As expected the ash composite samples contained only trace amounts of PAH (<0.5 µg/g). The two feed oil composite samples, however, contained 56 and 90 µg/g PAH, with the major compounds being napthalene (73, 30 µg/g) and phenanthrene (15, 18 µg/g).

Table 2 presents details of the two runs on the Unit A burner emissions.

TABLE 2

UNIT A

TEST PARAMETER		TESTING DATE April 18, 1990		
		RUN 1 1250-1330h	RUN 2 1429-1519h	AVERAGE
Temperature	°F	473	472	472
Static Pressure	in. H_2O	0	0	0
Average Velocity	fps	8.2	6.9	7.6
Flow Rate	sdcfm (@20°C)	47	40	44
	sdm^3/min (@20°C)	1.3	1.1	1.2
Moisture	% (v/v)	9.8	9.3	9.6
CO_2	%	8.8	8.8	8.8
O_2	%	6.6	6.6	6.6
N_2	%	84.6	84.6	84.6
Carbon Monoxide	%	ND	ND	ND
Sample Volume	scf	37.9	21.8	-
Particulates	mg/m^3	25.7	23.6	24.7
Hydrogen Chloride	mg/m^3	12.6	40.9	26.8
Hydrogen Fluoride	mg/m^3	0.3	5.8	3.1
Hydrogen Bromide	mg/m^3	0.9	3.4	2.2
Sulfur Dioxide	mg/m^3	591	619	605
Nitrogen Dioxide	mg/m^3	255	67.5	161
Total Hydrocarbons as C_6	ppm	<1	<1	<1
Average Isokineticity	%	146	152	149

ND = Not detected. Detection limit for CO = 0.03% (300 ppm)

Table 3 presents details of the two runs on the Unit B burner emissions.

TABLE 3

UNIT B

TEST PARAMETER		TESTING DATE April 19, 1990 RUN 3 1045-1125h	RUN 4 1253-1322h	AVERAGE
Temperature	°F	671	766	719
Static Pressure	in. H_2O	0	0	0
Average Velocity	fps	6.4	9.6	8.0
Flow Rate	sdcfm (@20°C)	31	43	37
	sdm^3/min (@20°C)	0.9	1.2	1.0
Moisture	% (v/v)	11.7	10.4	11.0
CO_2	%	6.4	7.0	6.7
O_2	%	13.1	12.4	12.7
N_2	%	80.8	80.6	80.7
Carbon Monoxide	%	0.06	ND	0.03
Sample Volume	scf	19.8	21.2	20.0
Particulates	mg/m^3	947	406	677
Hydrogen Chloride	mg/m^3	3.7	8.0	5.9
Hydrogen Fluoride	mg/m^3	0.7	0.3	0.5
Hydrogen Bromide	mg/m^3	1.2	0.6	0.9
Sulfur Dioxide	mg/m^3	551	600	576
Nitrogen Dioxide	mg/m^3	50	69	60
Total Hydrocarbons as C_6	ppm	1.65	<1	0.8
Average Isokineticity	%	103	89	96

ND = Not detected. Detection limit for CO = 0.03% (300 ppm)

Table 4 presents details of the one run on the Unit C burner emissions.

TABLE 4

UNIT C

TEST PARAMETER		TESTING DATE April 20, 1990 RUN 5 1102-1203h
Temperature	°F	595
Static Pressure	in. H_2O	0
Average Velocity	fps	6.0
Flow Rate	sdcfm (@20°C)	44
	sdm^3/min (@20°C)	1.3
Moisture	% (v/v)	5.3
CO_2	%	7.4
O_2	%	11.8
N_2	%	80.6
Carbon Monoxide	%	0.05
Sample Volume	scf	12.0
Particulates	mg/m^3	590
Hydrogen Chloride	mg/m^3	5.7
Hydrogen Fluoride	mg/m^3	0.4
Hydrogen Bromide	mg/m^3	0.7
Sulfur Dioxide	mg/m^3	780
Nitrogen Dioxide	mg/m^3	122
Total Hydrocarbons as C_6	ppm	3.1
Average Isokineticity	%	86

Table 5 presents details of the two runs on the Unit D burner emissions.

TABLE 5

UNIT D

TEST PARAMETER		TESTING DATE April 22, 1990 RUN 6 1057-1147h	RUN 7 1238-1328h	AVERAGE
Temperature	°F	511	515	513
Static Pressure	in. H_2O	0	0	0
Average Velocity	fps	5.8	5.9	5.8
Flow Rate	sdcfm (@20°C)	62	58	60
	sdm^3/min (@20°C)	1.7	1.6	1.6
Moisture	% (v/v)	4.5	11.1	7.8
CO_2	%	0.74	1.03	0.88
O_2	%	20.4	20.0	20.2
N_2	%	78.7	78.9	78.8
Carbon Monoxide	%	ND	ND	ND
Sample Volume	scf	11.4	10.9	11.2
Particulates	mg/m^3	104.6	14.9	59.8
Hydrogen Chloride	mg/m^3	3.1	4.3	3.7
Hydrogen Fluoride	mg/m^3	<0.3	<0.3	<0.3
Hydrogen Bromide	mg/m^3	0.9	<0.6	<0.7
Sulfur Dioxide	mg/m^3	514	384	449
Nitrogen Dioxide	mg/m^3	89	113	101
Total Hydrocarbons as C_6	ppm	<1	<1	<1
Average Isokineticity	%	92	94	93

ND = Not detected. Detection limit for CO = 0.03% (300 ppm)

Table 6 presents details of the one run on the Unit E burner emissions.

TABLE 6

UNIT E

TEST PARAMETER		TESTING DATE April 23, 1990 RUN 8 0935-1020h
Temperature	°F	442
Static Pressure	in. H_2O	0
Average Velocity	fps	5.6
Flow Rate	sdcfm (@20°C)	64
	sdm^3	1.8
Moisture	% (v/v)	5.2
CO_2	%	1.2
O_2	%	19.6
N_2	%	78.8
Carbon Monoxide	%	ND
Sample Volume	scf	10.4
Particulates	mg/m^3	248
Hydrogen Chloride	mg/m^3	3.5
Hydrogen Fluoride	mg/m^3	1.8
Hydrogen Bromide	mg/m^3	0.9
Sulfur Dioxide	mg/m^3	267
Nitrogen Dioxide	mg/m^3	113
Total Hydrocarbons as C_6	ppm	0.5
Average Isokineticity	%	93

ND = Not detected. Detection limit for CO = 0.03% (300 ppm)

Table 7 presents details of the one run on the Unit F burner emissions.

TABLE 7

UNIT F

TEST PARAMETER		TESTING DATE April 23, 1990 RUN 9 1350-1435h
Temperature	°F	586
Static Pressure	in. H_2O	0
Average Velocity	fps	7.6
Flow Rate	sdcfm (@20°C)	69
	sdm^3/min (@20°C)	1.9
Moisture	% (v/v)	12.7
CO_2	%	0.4
O_2	%	20.4
N_2	%	79.2
Carbon Monoxide	%	<0.01
Sample Volume	scf	12.2
Particulates	mg/m^3	131
Hydrogen Chloride	mg/m^3	29.3
Hydrogen Fluoride	mg/m^3	1.6
Hydrogen Bromide	mg/m^3	<0.6
Sulfur Dioxide	mg/m^3	448
Nitrogen Dioxide	mg/m^3	146
Total Hydrocarbons as C_6	ppm	1.2
Average Isokineticity	%	98

Table 8 presents a comparison of the average readings from the six burners.

TABLE 8

BURNER EMISSIONS COMPARISON

TEST PARAMETER		UNIT A Apr 18	UNIT B Apr 19	UNIT C Apr 20	UNIT D Apr 22	UNIT E Apr 23	UNIT F Apr 23	AVERAGE OF SIX LOCATIONS	SCHED.2 EMISSION CRITERIA (1)
Temperature	°F	472	719	595	513	442	586	555	-
Average Velocity	fps	7.6	8.0	6.0	5.8	5.6	7.6	6.8	-
Flow Rate	sdcfm	44	37	44	60	64	69	53	-
	sdm^3/min	1.2	1.0	1.3	1.6	1.8	1.9	1.5	-
Moisture	% (v/v)	9.6	11.0	5.3	7.8	5.2	12.7	8.6	-
CO_2	%	8.8	6.7	7.4	0.9	1.2	0.4	2.8	-
O_2	%	6.6	12.7	11.8	20.2	19.6	20.4	17.6	-
N_2	%	84.6	80.7	80.6	78.8	78.8	79.2	79.4	-
Carbon Monoxide	%	ND	<0.04	0.05	ND	ND	<0.01	<0.02	475 ppm
Particulates	mg/m^3	25	677	590	60	248	131	288	50
	g/h	1.8	40.6	46.0	5.8	26.8	14.9	25.9	-
Hydrogen Chloride	mg/m^3	26.8	5.9	5.7	3.7	3.5	29.3	12.5	70
Hydrogen Fluoride	mg/m^3	3.1	0.5	0.4	<0.3	1.8	1.6	1.3	5
Hydrogen Bromide	mg/m^3	2.2	0.9	0.7	<0.7	0.9	<0.6	<1.0	-
Sulfur Dioxide	mg/m^3	605	576	780	449	267	448	521	250
	g/h	43.6	34.6	60.8	43.1	28.8	51.1	46.9	-
Nitrogen Dioxide	mg/m^3	161	60	122	101	113	146	117	300
Total Hydrocarbons as C_6	ppm	<1	0.8	3.1	<1	0.5	1.2	<1.3	45 (2)
Average Isokineticity	%	149	96	86	93	93	98	-	-

ND = Not detected. Detection limit for CO = 0.03% (300 ppm)

(1) Special Waste Thermal Treatment Facilities, Waste Management Act

(2) 45 ppm as CH_4 = 7.5 ppm as C_6

TABLE 9

METAL EMISSIONS COMPARISON
CLASS I, II & III METALS, SPECIAL WASTE, B.C.
SCHEDULE 2, WASTE MANAGEMENT ACT

		UNIT A	UNIT B	UNIT C	UNIT D	UNIT E	UNIT F	AVERAGE
Class I Metals, mg/m^3	**Limit**							
Lead	5	0.38	0.30	2.62	0.56	0.62	0.53	0.84
Antimony	5	0.01	<0.01	0.02	<0.01	0.01	0.01	0.01
Copper	5	0.04	0.23	0.33	0.38	0.36	0.31	0.28
Manganese	5	0.10	0.04	0.14	0.17	0.12	0.12	0.12
Vanadium	5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	5	0.54	1.22	3.48	3.01	1.32	1.65	1.87
Class II Metals, mg/m^3	**Limit**							
Arsenic	5	<0.01	<0.01	0.11	0.02	0.01	0.01	0.02
Chromium	5	0.06	0.12	0.36	0.48	0.54	0.33	0.32
Cobalt	5	<0.01	<0.01	0.01	0.01	0.01	0.01	<0.01
Nickel	5	0.03	0.08	0.35	0.32	0.50	0.27	0.26
Selenium	5	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
Tellurium	5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Class III Metals, mg/m^3	**Limit**							
Thallium	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	0.2	0.01	0.01	0.09	0.03	0.04	0.04	0.04
Mercury	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

TABLE 10

BURNER EMISSIONS
HYDROCARBON SOLVENTS, mg/m^3

LOCATION	METHYL ETHYL KETONE		ACETONE		BENZENE		TOLUENE		ETHYL-BENZENE		XYLENE		CUMENE	
	Run 1	Run 2	Run 1	Run 2	Run 1	Run 2	Run 1	Run 2	Run 1	Run 2	Run 1	Run 2	Run 1	Run 2
Unit A	0.9	ND	1.9	ND	1.9	ND	1.8	1.6	0.3	ND	1.6	0.1	0.1	ND
Unit B	ND	ND	ND	ND	ND	ND	0.4	0.4	ND	ND	0.3	0.1	ND	ND
Unit C	0.5	ND	0.7	ND	1.7	ND	1.7	0.1	0.1	ND	0.5	ND	ND	ND
Unit D	ND	ND	ND	ND	ND	2.8	0.1	1.7	ND	0.1	ND	0.6	ND	ND
Unit E	ND	ND	ND	ND	ND	ND	0.2	ND	ND	ND	ND	ND	ND	ND
Unit F	11.0	ND	0.6	ND	1.1	ND	7.5	ND	1.3	ND	6.3	ND	0.1	ND
Average	<1.0		<0.3		<1.0		1.3		<0.2		<1.0		<0.1	

ND = Not detected, less than 0.1 mg/m^3

TABLE 11

ASH ANALYSIS
MAJOR METALS, % COMPOSITION

	UNIT A	UNIT B	UNIT C	UNIT D	UNIT E	UNIT F	AVERAGE
Phosphorus	11.0	15.0	11.0	14.0	15.0	15.0	13.5
Magnesium	2.4	5.1	3.6	6.0	5.0	3.8	4.3
Iron	2.4	1.2	1.0	1.4	1.5	1.6	1.5
Zinc (1)	2.3	4.2	5.5	3.2	3.9	3.8	3.8
Calcium	1.9	4.5	3.0	5.7	5.2	3.8	4.0
Manganese (1)	0.91	0.23	0.24	0.13	0.16	0.19	0.31
Lead (1)	0.61	0.72	0.91	0.32	0.62	1.20	0.73
Sodium	0.49	0.24	0.68	0.21	0.29	0.59	0.42
Potassium	0.24	0.14	0.22	0.20	0.31	0.33	0.24
Copper (1)	0.10	0.21	0.23	0.31	0.32	0.28	0.24
Aluminum	0.07	0.13	0.06	0.05	0.05	0.07	0.07
Boron	0.07	0.26	0.05	0.17	0.14	0.08	0.13
Tin	0.05	0.02	0.02	0.02	0.02	0.04	0.02
Molybdenum	0.05	0.03	0.06	0.05	0.03	0.04	0.04
Chromium (2)	0.05	0.03	0.02	0.03	0.02	0.04	0.03
Silicon	0.04	0.13	0.04	0.09	0.10	0.04	0.07
Cadmium (3)	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel (2)	0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
Barium	<0.01	0.01	0.02	<0.01	0.02	0.02	0.01

(1) Class I Metals, Special Waste - Schedule 2, Waste Management Act, add Antimony (<0.01%) and Vanadium (<0.002%)

(2) Class II Metals, add Arsenic (<0.01%), Cobalt (<0.001%), Selenium (<0.001%) and Tellurium (<0.0001%)

(3) Class III Metals, add Thallium (<0.001%) and Mercury (<0.00001%)

TABLE 12

FEED OIL ANALYSIS
MAJOR METALS, PPM CONCENTRATION (mg/L)

	UNIT A	UNIT B	UNIT C	UNIT D	UNIT E	UNIT F	AVERAGE
Phosphorus	940	1000	1100	890	760	820	918
Zinc [1]	910	1000	990	800	550	700	825
Magnesium	520	690	430	520	380	400	490
Iron	390	96	170	79	71	120	154
Calcium	380	450	650	540	380	430	472
Lead [1]	230	200	200	61	69	300	177
Manganese [1]	140	45	34	22	23	95	60
Sodium	86	46	78	27	33	71	57
Potassium	66	28	67	39	44	77	54
Silicon	24	23	31	19	14	18	22
Copper [1]	22	32	54	52	30	35	38
Aluminum	21	11	15	7	6.5	11	12
Tin	11	2.9	6.1	3.1	2.1	5.2	5.1
Boron	10	36	9.3	24	16	7.1	17.1
Molybdenum	8.3	3.6	12.0	6.3	2.4	4.0	6.1
Chromium [2]	7.4	4.0	5.0	1.9	1.1	4.4	4.0
Antimony [1]	6.9	0.8	16.0	1.4	0.7	1.5	4.6
Cadmium [3]	4.1	0.9	1.6	0.7	0.8	1.0	1.5
Barium	3.4	6.3	6.0	2.2	2.8	7.7	4.7
Nickel [2]	2.8	0.8	1.3	0.3	0.3	1.5	1.2
Titanium	1.8	3.7	1.7	1.9	2.9	7.5	3.2
Lithium	1.5	1.9	2.3	2.4	3.2	3.4	2.4
Strontium	1.1	1.4	1.6	0.8	0.7	1.3	1.2

[1] Class I Metals: Special Waste - Schedule 2, Waste Management Act, add Vanadium (ND)

[2] Class II Metals: add Arsenic (ND), Cobalt (0.10), Selenium (<0.04), and Tellurium (<0.01) mg/L

[3] Class III Metals: add Thallium (<0.01) and Mercury (<0.01) mg/L.

ND = Not detected.

TABLE 13

SULFUR ANALYSIS, ASH - FEED OIL

LOCATION	ASH Sulfur %	ASH Carbon %	FEED OIL Sulfur %
Unit A			0.61
Unit B	4.6(1)	33.5(1)	0.54
Unit C			0.62
Unit D			0.50
Unit E	5.6(2)	29.9(2)	0.66
Unit F			0.67

(1) Yellowknife ash composite.

(2) Hay River ash composite.

TABLE 14

FEED OIL - ASH
POLYNUCLEAR AROMATIC HYDROCARBON ANALYSIS

COMPOUNDS	C O N C E N T R A T I O N S (µg/g)			
	YELLOWKNIFE ASH COMP.	YELLOWKNIFE OIL COMP.	HAY RIVER ASH COMP.	HAY RIVER OIL COMP.
Naphthalene	<0.25	72.8	0.25	29.7
Acenaphtylene	<0.25	<2.5	<0.25	<2.5
Acenaphthene	<0.25	<2.5	<0.25	<2.5
Fluorene	<0.25	<2.5	<0.25	<2.5
Phenanthrene	<0.25	14.8	0.26	17.6
Anthracene	<0.25	2.71	<0.25	4.55
Fluoranthene	<0.25	<2.5	<0.25	<2.5
Pyrene	<0.25	<2.5	<0.25	<2.5
Benzo(a)anthracene	<0.25	<2.5	<0.25	<2.5
Chrysene	<0.25	<2.5	<0.25	<2.5
Benzo(b)fluoranthene	<0.25	<2.5	<0.25	<2.5
Benzo(k)fluoranthene	<0.25	<2.5	<0.25	4.17
Benzo(a)pyrene	<0.25	<2.5	<0.25	<2.5
Dibenzo(a,h)anthracene	<0.25	<2.5	<0.25	<2.5
Benzo(g,h,i)perylene	<0.25	<2.5	<0.25	<2.5
Indeno(1,2,3-cd)pyrene	<0.25	<2.5	<0.25	<2.5
TOTAL	<0.4	90.3	<0.4	56.0

IV. APPENDICES

1. Stack Sampling Field Log Sheets
2. Particulate Analysis
3. Feed Oil Analysis
4. Ash Analysis
5. Hydrocarbon Solvent Analysis
6. PAH Analysis
7. Feed Oil Sulfur Analysis
8. Halide Analysis
9. Federal Municipal Incinerator Discharge Limits and Anticipated Emissions

STACK SAMPLING FIELD TEST REPORT

PLANT: UNIT A

LOCATION: YELLOWKNIFE

STACK DIA. (In.): 6" (SINGLE WALL) $A_s = .196\ ft^2$ — 169 / 144 / 66

DATE: APRIL 18, 1990

TIME (24-HR CLOCK): 1250 - 1330 — 32 / 411

RUN NUMBER: 1 SOx

OPERATORS: AIKEN - CALBICK

STATIC PRESSURE (In. W.G.): 0

P_{bar} = 29.00 @ 0900

P BAR: (Barometric Press.) 29.00 + (0) = 29.00 (In.HG) — 140 / 135

$P_{sn} = \frac{29.00 + (0)}{13.5}$ — S-TYPE USED FOR TRAV (1PT) .18 / 293

CP (PITOT COEF): 0.286 #2 DGM AERO DGM

ORIFICE METER COEF: 0.969 NOT OP

ΔH@ no orifice USED AFTER INITIAL LEAK CHECK!

PROBE LENGTH (FT): 3

NOZZLE DIA. (In): 0.75 $A_n = 0.00307\ ft^2$

LEAK RATE: Before: 462.985 − 462.983 = 0.002 Cu.Ft/Min. — SWITCH TO NO 2 BCR DGM.

After: 515.190 − 515.188 = 0.002 Cu.Ft/Min.

SILICA GEL: I — 1204.7 − 1194.0 = 10.7 G

1st IMPINGER: DI — 137 − 100 = 37 G

2nd IMPINGER: DI — 120 − 100 = 20 G

3rd IMPINGER: — 10 − 0 = 10 G

4th IMPINGER: H_2O_2 — 106 − 100 = 6 G

5th IMPINGER: H_2O_2 — 104 − 100 = 4 G

FILTER NUMBER: 517

FILTER: (#1) 1.1520 − 1.1254 = 0.0266 g

V_{lc} = 87.7 g

PROBE & CYCLONE WASHES: 51.326 − 51.325 = 0.001 g

WEIGHT: [illegible] SO_2: 634.4 SO_3: ____ H_2SO_4 ____

M = 0.0276 g

T_s °C °F — PARTICULATE SAMPLING DATA — ΔP — t_{hr} — V_n → 15 cfm

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (In. wg.)	Orifice Meter (In. wg.)	Gas Meter Volume (Ft.³)	Pump Vacuum (In. Hg.)	
	0									474.530		
	5	549	277	50	295	21.5	75	0.01	1.24	480.43	4.5	1.2
	10	410	290	49	303	21.5	75	0.01		486.15	5.0	1.1
	15	386	290	53	301	21.5	75	0.01		491.92	5.0	1.16
	20	479	290	60	303	22	73	0.01		497.64	5.0	
	25	492	290	63	305	22	73	0.01		503.35	5.0	
	30	496	268	54	311	21	71	0.01		509.91	5.0	
	35	501	291	61	304	20	70	0.01		515.178	5.0	
												1.16 cfm
		FILLED 1 LECTURE BOTTLE + 1-2 RAC-S										
		473°F				21.35	73.1			40.648	x.969	
		+460				70.4		VAP				
	35					74.84		0.10				39.39

933°R — 532°K

STACK SAMPLING FIELD TEST REPORT

PLANT: UNIT A

LOCATION: YELLOWKNIFE

STACK DIA. (In.): 6" ⇒ A_s = 0.1963 ft^2

DATE: APRIL 18, 1990

TIME (24-HR CLOCK): 1429 -

RUN NUMBER: 2 SOx

OPERATORS: AIKEN - CALBICK

STATIC PRESSURE (In.W.G.): 0

P BAR: 29.00 @ 1400 (Barometric Press.) (In.HG)
29.00 + (0) = 29.00

2.5 S-TYPE USED FOR TRAV

CP (PITOT COEF): 0.836 (1 PT)
#2

ORIFICE METER COEF: 0.969

ΔH@ no orifice used

PROBE LENGTH (FT): 3

NOZZLE DIA. (In): ½ ⇒ A_n = 0.00142 ft^2

LEAK RATE: Before: 515.293 − 515.293 = 0.000 Cu.Ft/Min.

After: 538.563 − 538.561 = 0.002 Cu.Ft/Min.

L = [illegible]

SILICA GEL: II
1221.1 − 1214.6 = 6.5 G

1st IMPINGER: DI
136 − 100 = 36 G

2nd IMPINGER: DI
103 − 10.? = ? G

3rd IMPINGER:
1 − 0 = 1 G

4th IMPINGER: H_2O_2
100 − 100 = 0 G

5th IMPINGER: H_2O_2
101 − 100 = 1 G

V_{lc} = 47.5 g

FILTER NUMBER: 518

FILTER (#):
1.1693 − 1.1567 = 0.0126 g NBS

PROBE & CYCLONE WASHES:
50.292 − 50.290 = 0.002 g NBS

WEIGHT: (80) m 2
SO_2: 382.7 SO_3: ____ H_2SO_4 ____

M = 0.0146 g

PARTICULATE SAMPLING DATA

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Dust Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (In. wg.)	Orifice Meter (In. wg.)	Gas Meter Volume (Ft.³)	Pump Vacuum (In. Hg.)
	0									515.293	
	5.0	283	289	50	292	19	61	0.007		518.34	2.5
	10.0	297	✓	49	301	19	67	0.007		521.18	2.5
	15.0	302	286	49	294	19	67	0.007		524.0	2.5 .58
	20.0	516	286	49	299	19	67	0.007		526.79	2.5
pr chd.	25.0										
	30.0	568	286	49	301	18.5	66	0.007		529.9	2.5
	35.	544	285	47	295	18.5	66	0.00[illegible]		531.3	2.5
	40	545	286	48	300	19.5	66	0.007		533.65	2.5
	45	592	286	43	301	19	66	0.007		536.05	2.5 .48(46)
	50	598	287	48	300	19	66	0.007		538.45.3	2.5
		4745									
		NOVA									
		O_2	CO_2	CO							
at	1540	6.6	8.8-1.2	1 ppm							
						avg 18.3C					
		472				65.94	64.97			22.140	X.969
		932°R						Vel. Head			
	50					Tm	Tm	0.084	Orifice	Vm	22.44
						Tm	66.3°F				
							526°R				

2

STACK SAMPLING FIELD TEST REPORT

PLANT: UNIT 8

LOCATION: YELLOWKNIFE

STACK DIA. (In.): 6" ⇒ A_s = 0.19651 ft²

DATE: APRIL 19, 1990

TIME (24-HR CLOCK): 1045 - 11:25

RUN NUMBER: 3 - SO₂

OPERATORS: AIKEN - CALBICK

STATIC PRESSURE (In. W.G.): 0
29.37 @ 1300

P BAR: (Barometric Press.) (In.HG)

P_{sm} 29.37 + (0) = 29.37

CP (PITOT COEF): 0.374
#2 BCR SMALL

ORIFICE METER COEF: 0.969

ΔH @ 1.73

PROBE LENGTH (FT): 3

NOZZLE DIA. (In): ¾ ⇒ A_n = 0.00391 ft²

LEAK RATE: Before: 538.666 − 538.664 = 0.002 Cu. Ft/Min.

After: 559.339 − 559.336 = 0.003 Cu. Ft/Min.

196
150
14
.25
385

6" DIA

125
133
258

V_{lc} = 556

SILICA GEL: I — 1209.3 − 1204.7 = 4.6 G

1st IMPINGER: DI — 142 − 103 = 42 G

2nd IMPINGER: DI — 104 − 100 = 4 G

3rd IMPINGER: 4 − 0 = 4 G

4th IMPINGER: H_2O_2 — 100 − 100 = 0 G

5th IMPINGER: H_2O_2 — 101 − 100 = 1 G

FILTER NUMBER: 530

FILTER: (#) 1.5699 − 1.1476 = 0.4223 g ANS

PROBE & CYCLONE WASHES: 53.360 − 53.250 = 0.110 g ANS

WEIGHT: (@) mg
SO_2: 309.8 SO_3: ____ H_2SO_4 ____

M = 0.5323 g

PARTICULATE SAMPLING DATA

T_s °C °F ΔP ΔH

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (In. wg.)	Orifice Meter (In. wg.)	Gas Meter Volume (Ft.³)	Pump Vacuum (In. Hg.)
	0									538.666	
1	5	635	316	45	258	125	69	0.007	0.97	544.33	2.5
2	10	679	292	48	306	12.5	65	.007	.88	549.86	2.5
3	15	677	292	47	301	19	66	.007	.88	555	3.0
4	20	670	292	48	299	19	68	.007	.88	548	3.0
5	25	663	293	49	298	20	67	.007	.88	551.5	3.5
6	30	668	293	50	299	20.5	68	007	88	554.18	4.0
7	35	663	293	51	300	21	68	.007	.88	556.30	4.5
8	40	667	293	52	296	21	69	.007	.88	559.443	4.5
		T_s = 671.5 °R = 331.5 °R									
	NO/A @ 1140										
	O_2 2.9	CO_2 3.9-1.0		CO 0.99 °/₀		19.69°C					
						67.99°F	66.5°F				
		30 °/₀ OPACITY 1030									
		50 °/₀			1120	66.97°F					
						526.7 °R					
		olive	waxy dust					$\sqrt{\Delta P}$		20.777	x 0.969
	40	Total				Total	Total	0.084	Total	Total	20.13

.52

STACK SAMPLING FIELD TEST REPORT

PLANT: UNIT B

LOCATION: YELLOWKNIFE

STACK DIA. (in.): 6" ⇒ A_s = 0.196 ft²

DATE: APRIL 19, 1990

TIME (24-HR CLOCK): 1253 - 1322

RUN NUMBER: 4 - SOx

OPERATORS: AIKEN - CALBICK

STATIC PRESSURE (in. w.g.): 0

P BAR: (Barometric Press.) (In.HG)
P_{BA} = 29.37 + (0) = 29.37

CP (PITOT COEF): 0.374
#2 DRY SMAL

ORIFICE METER COEF: 0.969

ΔH@ 1.73

PROBE LENGTH (FT): 3

NOZZLE DIA. (in): 0.75 ⇒ A_n = 0.0031 ft²

LEAK RATE: Before: 559.543 − 559.542 = 0.001 Cu.Ft/Min.

After: 582.038 − 582.015 = 0.003 Cu.Ft/Min.

168
180
1.59
407

6" DIA

134
155
289

SILICA GEL: 1225.8 − 1221.1 = 4.7 G

1st IMPINGER: DI 140 − 140 = 0 G

2nd IMPINGER: DI 103 − 100 = 3 G

3rd IMPINGER: 1 − 0 = 1 G

4th IMPINGER: H_2O_2 109 − 100 = 9 G

5th IMPINGER: H_2O_2 100 − 100 = 0 G

V_{lc} = 43.7 g

FILTER NUMBER: 521

FILTER: #2 1.3472 − 1.1434 = 0.2038 g ABS

PROBE & CYCLONE WASHES: 74.285 − 74.245 = 0.040 g ABS

WEIGHT: (ABS) mg
SO_2: 360.5 SO_3: ____ H_2SO_4 ____

M = 0.2437 g

PARTICULATE SAMPLING DATA

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp °C Inlet (°F)	Dry Gas Meter Temp °C Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Dry Gas Meter Reading (Cu. ft.)	Pump Vacuum (in. Hg.)
	0									559.543	
1	5	718	292	50	300	22.5	73	0.010	1.25	562.8	3.5
2	10	721	294	50	298	23	73	.010	1.25	565.91	4
3	15	776	294	50	300	23	73	.010	1.25	569.93	4
4	20	821	294	49	300	23.5	74	.010	1.25	573.98	4
5	25	791	295	52	300	24	75	.011	1.45	575.43	5
6	30	772	294	54	296	24	75	.012	1.43	578.72	5
7	35	761	294	55	299	24.5	75	.012	1.43	582.022	5
		T_s = 765.7°F									
		= 1225.7°R				23.5°C			ΔH		
NOVA	@	1306							1.33		
	O_2	CO_2	CO			74.3°F	74°F				
	5.1	9.9	0.12 %	change gas bottle (time @ 1307)							
@1315	5.3	10.1	279 ppm			74.15°F					
@1332	7.3	9.0	120 ppm			534.15°R					
average at 1336 = < 5 %										22.479X	0.962=
								√ΔP			
	35							0.103			21.78

STACK SAMPLING FIELD TEST REPORT

PLANT: UNIT C

LOCATION: YELLOWKNIFE

STACK DIA. (In.): 7" ID ⇒ A_s = 0.267 ft² 154 232 386

DATE: APRIL 20, 1990

TIME (24-HR CLOCK): 1102 - 1203

RUN NUMBER: 5 - SOx

OPERATORS: AIKEN - CALBICK

STATIC PRESSURE (In.W.G.): 0
29.20 @ 1130

P BAR: (Barometric Press.) (In.HG)
P_{BAR} = 29.20 + (0) = 29.20 141
2.5 S-TYPE USED FOR TRAV. (IPT) 140 16

CP (PITOT COEF): 0.84 B 29 S-Type
#2 BCA SMALL

ORIFICE METER COEF: 0.969

ΔH@ 1.734
USE 18" EXTENSION ON ★ HOOKED UP
PROBE LENGTH (FT): 3' #2 DGM BACKW AT FIRST !

NOZZLE DIA. (In): 0.5 ⇒ A_n = 0.00fft²
7" STK ID

LEAK RATE: Before: 591.951 - 591.952 = 0.001 Cu.Ft/Min.
ECONO-HEATER
ENERGYTECH CORP
MODEL 3017
After: 594.751 - 594.748 = 0.003 Cu.Ft/Min.

SILICA GEL: I — 1211.6 − 1209.3 = 2.3 G
1st IMPINGER: DI — 110 − 100 = 10 G
2nd IMPINGER: DI — 100 − 100 = 0 G
3rd IMPINGER: — 1 − 0 = 1 G
4th IMPINGER: H_2O_2 — 101 − 100 = 1 G
5th IMPINGER: H_2O_2 — 100 − 100 = 0 G
V_{lc} = 19.3g
FILTER NUMBER: 522
FILTER: #1 AT FIRST ! 1.2299 − 1.1288 = 0.1011 g ADS
PROBE & CYCLONE WASHES: 79.600 − 79.500 = 0.100 g ADS
WEIGHT: (g) mg
SO_2: 158.6 SO_3: ____ H_2SO_4 ____
M = 0.2011 g

PARTICULATE SAMPLING DATA

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (In. w.g.)	Orifice Meter (In. w.g.)	Gas Sample Volume (Ft.³)	Pump Vacuum (In. Hg.)
	0									591.951	
1	5	590	291	40	297	19	70	.005	0.13	593.97	1.5
2	10		291	40	299	19	70	.005	0.13	583	2
3	15	600	290	40	302	19	70	.005	0.13	585.10	2
4	20		290	41	306	19.5	70	.005	0.13	586.17	2
5	25		291	41	308	20	70	.005	0.13	587.23	2
6	30		287	42	303	20	70	.005	0.13	588.3	2
7	35		291	43	297	19.5	70	.005	0.13	589.3	2
8	40		290	43	298	19.5	70	.005	0.13	590.43	2
9	45		290	44	308	19.5	70	.005	0.13	591.5	2
10	50		290	44	298	19.5	70	.005	0.13	592.57	2
11	55		291	44	307	20	70	.005	0.13	593.67	2
12	60		291	44	309	19.5	70	.005	0.13	594.793	2
	OPACITY										
	@	1045	40	10	140 °F	TEMP	IN	EGE	EXHAUST	SCREEN	TO ROOM
595°F		1130	20		114						
↓		1217	20		116	19.5C					
1055°R						↓					
						67.1°F	70°F				
NOVA	O_2	CO_2	CO								
1138	10.1	7.0-1.2	333			69.	55°F			127-13	X0.969 =
1204	10.1	7.2-1.2	556			529.	55°R				
								0.871			12.35

STACK SAMPLING FIELD TEST REPORT

PLANT: UNIT D

LOCATION: HAYRIVER

STACK DIA. (In.): 8" ID ALSO HAS OUTER INS. COVERING

DATE: APRIL 22, 1990 $A_s = 0.349\ ft^2$

TIME (24-HR CLOCK): 1057 - 1147

RUN NUMBER: 6-50x

OPERATORS: AIKEN - CALBICK

STATIC PRESSURE (In. W.G.): 0

P BAR: 29.25 (Barometric Press.) + (0) = 29.25 (In. HG)
2925 @ 1000

CP (PITOT COEF): USE 2.5 S-TYPE FOR TRAV. 0.834 0.86 (1 PT)
#2 v SMALL

ORIFICE METER COEF: 0.969

ΔH @ 1.73

PROBE LENGTH (FT): 18" EXTENSION ON, 3'

NOZZLE DIA. (In): 0.50 $\rightarrow A_n = 0.00545\ ft^2$

LEAK RATE: Before: 594.687 − 594.685 = 0.002 Cu. Ft/Min.

After: 606.714 − 606.710 = 0.004 Cu. Ft/Min.

IMP CONTENTS
248
1.5.9
407

IMP WASHES
242
286
528

SILICA GEL: I ADD weight from Spare Impinger 1234.4 + 4.0 − 1237.0 = 4.4 G

1st IMPINGER:

SUCK BACK! AT END

2nd IMPINGER: 100 G; 100 G

3rd IMPINGER: 0 G

DI & H_2O_2 comb.

4th IMPINGER: 100 G

5th IMPINGER: 100 G

V_{lc} = 11.4 g

FILTER NUMBER: 524

FILTER: (#1) 1.1446 − 1.1328 = 0.0118 g ANS

PROBE & CYCLONE WASHES: 50.752 − 50.730 = 0.022 g ANS

WEIGHT: (B) mg
SO_2: 166.1 SO_3: ____ H_2SO_4 ____

M = 0.0338 g

PARTICULATE SAMPLING DATA

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (In. wg.)	Orifice Meter (In. wg.)	Gas Meter Volume (Ft.³)	Pump Vacuum (In. Hg.)
	0						.5		594.687	
1	5	480	288	62	302	18	66	0.005	0.16	595.98	2
2	10	485	288	62	298	18	65	0.005	0.16		2
3	15	485	288	63	291	18	65	.005	0.16	598.75	2
4	20	495	288	65	301	18	65	.005	.16	599.59	2
5	25	500	288	68	293	18	65	.005	.16	600.71	2
6	30	510	288	72	297	18	65	.005	.16	601.91	2
7	35	525	288	71	296	18	65	.005	.16	603.09	2
8	40	545	288	73	297	18	65	.005	.16	604.29	2
9	45	545	287	72	299	18	65	.005	.16	605.45	2
10	50	545	288	71	300	17.5	65	.005	.16	606.64	2
						17.33°C				
Apparatus @	1130	10-30 %				63.1°F	65.1°F			
						463.1°R				
	ANVA		O_2	CO_2	CO	M 7°F				
at	1130		17.6	1.7-.8	.40 %					
	1152		18.2	0.3<.2	3 ppm					
						523.1°R				
		T_s 514.5°F = 974.5°R							119.3	X 0.969
							ΔP			
	50						0.071			11.53

STACK SAMPLING FIELD TEST REPORT

PLANT: UNIT 6

LOCATION: HAYRIVER

STACK DIA. (In.): 8" ID ALSO HAS OUTER INS COV. (A_s = 0.3499 ft²)

DATE: APRIL 22, 1990

TIME (24-HR CLOCK): 1238 - 1328

RUN NUMBER: 7-SOx

OPERATORS: AIKEN - CALBICK

STATIC PRESSURE (In. W.G.): 0

P BAR: 29.27 @ 1400 (Barometric Press.) (In. HG)

P_{sm} = 29.27 + (0) = 29.27

CP (PITOT COEF): 0.84 0.886 Use 2.5 STYPE FOR TRAN (1 PT)

ORIFICE METER COEF: 0.969 #2 SMALL

ΔH@ 1.73

PROBE LENGTH (FT): 3 18" EXTENSION ON

NOZZLE DIA. (In): 0.50 → A_n = 0.0014 ft²

ASH SAMPLE NEXT DAY

LEAK RATE: Before: 606.760 − 606.757 = 0.003 Cu. Ft/Min.

After: 618.213 − 618.208 = 0.005 Cu. Ft/Min.

L = max. allowable leak

	169	
	223	
	43	
	435	
	163	
	150	
	313	

SILICA GEL: II — 1246.1 − 1242.2 = 3.9 G

1st IMPINGER: DI — 112 − 100 = 12 G

2nd IMPINGER: DI — 107 − 100 = 7 G

3rd IMPINGER: 3 − 0 = 0 G

4th IMPINGER: H_2O_2 — 101 − 100 = 1 G

5th IMPINGER: H_2O_2 — 103 − 100 = 3 G

V_{lc} = 28.9

FILTER NUMBER: 523

FILTER: (H ₂) 1.1350 − 1.1304 = 0.0046 g ABS

PROBE & CYCLONE WASHES: 56.390 − 56.390 = 0 g ABS

WEIGHT: (g) mg

SO_2: 118.0 SO_3: ____ H_2SO_4: ____

m = 0.0046 g

PARTICULATE SAMPLING DATA

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head ΔP (In. wg.)	Orifice Meter ΔH (In. wg.)	Gas Meter Volume (Ft.³)	Pump Vacuum (In. Hg.)
	0									606.760	
1	5		290	62	287	17.5	65	0.005	.16	609.37	1.5
2	10		287	61	295	17	64	.005	.16	609.51	1.5
3	15	540	287	61	295	17	64	.005	.16	610.18	1.5
4	20		287	60	291	17	64	.005	.15	611.31	1.5
5	25		283	59	297	17	64	.005	.15	612.4	1.5
6	30		289	59	296	17	64	.005	.15	613.58	1.5
7	35		288	59	296	17	64	.005	.15	614.7	1.5
8	40		288	59	304	17	64	.005	.15	615.87	1.5
9	45	490	288	59	296	17	64	.005	.15	617.03	1.5
10	50	↓	289	60	288	17	64	.005	.15	618.150	1.5
		515°F				↓	↓			↓	.23
		↓									
		975°R									
	Nom		CO_2	CO							
at 1250		189-.8	1.2-.9	-3 ppm							
		18.5-.6	.4	-7							
						17.05°C					
						62.7°F	64.1°F				
Orsat											
@ 1249		21.0%				63.4°F		↓ΔP		11.390	x0.969
						523.4°R					
						[illegible]	[illegible]				
	50	[illegible]				[illegible]		0.071	[illegible]	[illegible]	11.04

STACK SAMPLING FIELD TEST REPORT

PLANT: UNIT E

LOCATION: HAYRIVER

STACK DIA. (In.): 8" ID (HAS OUTER INS. COV. ALSO) → $A_s = 0.349 ft^2$

DATE: APRIL 23, 1990

TIME (24-HR CLOCK): 0925-1020

RUN NUMBER: 8-50

OPERATORS: AIKEN - CALBICK

STATIC PRESSURE (In.W.G.): 0

P BAR: 29.42 @ 0830 (Barometric Press.) 29.45 @ 1015 h (In.HG)

P_{ss} = 29.44 + (0) = 29.44

CP (PITOT COEF): 0.84 0.836 #2 BCR-SMALL USE 2.5' S-TYPE FOR #28 CAT SMALL TRAV (INT)

ORIFICE METER COEF: 0.969

ΔH@ 1.73

PROBE LENGTH (FT): 3 12" EXTENSION ON

NOZZLE DIA. (In): 0.50

LEAK RATE: Before: - OK. Cu.Ft/Min.

After: 6.229.96 - 229.94 = 0.002 Cu.Ft/Min.

FCE CLNOUT @ 0800

ASH SAMPLE TAKEN FROM CLNOUT

LITE FCE

AT 0830

SAME MODEL AS AT DEAN OFFICE

DRILL PART PROBE & CYCLONE WASHES:

PORT 4' UP FROM DAMPER (USE DAMPER FOR OTHER 3 PROBES)

WEIGHT: (8) mg

SO_2 18.4 SO_3 ____ H_2SO_4 ____

M = 0.07279

SILICA GEL:	1248.1 − 1246.1 = 2.0 G
1st IMPINGER: DI	106 − 100 = 6 G
2nd IMPINGER: DI	101 − 100 = 1 G
3rd IMPINGER:	1 − 0 = 1 G
4th IMPINGER: H_2O_2	102 − 100 = 2 G
5th IMPINGER: H_2O_2	102 − 100 = 2 G
FILTER NUMBER:	519
FILTER: #3	1.1374 − 1.1357 = 0.0017 g MB
PROBE & CYCLONE WASHES:	74.121 − 74.050 = 0.071 g MB

84 + 156 + 230 = 470

163 + 134

V_{LC} = 12.0

PARTICULATE SAMPLING DATA

Sampling Point Number	Clock Time	T_s Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp °C Inlet (°F)	Dry Gas Meter Temp °C Outlet (°F)	Δp Velocity Head (In. wg.)	ΔH Orifice Meter (In. wg.)	Gas Meter Volume (Ft.³)	Pump Vacuum (In. Hg.)
	0	444 @ 0915								619.211	
1	5		289	50	290	16	62	0.005	0.16	619.40	1.5
2	10		291	50	288	16	62	.005	.16	620.55	1.5
3	15		288	50	294	16	62	.005	.16	621.72	1.5
4	20		283	50	294	15.5	61	.005	.16	622	1.5
5	25	440	282	48	294	15.5	61	.005	.16	624.13	1.5
6	30		287	48	295	15.5	61	.005	.16	625.30	1.5
7	35		288	49	297	15	60	.005	.16	626.53	1.5
8	40		287	49	299	15	60	.005	.16	627.70	1.5
9	45		287	49	291	15	60	.005	.16	628.913	1.5
NOVA		O_2	CO_2	CO							
0905		18.0	0.7	6 ppm							
		18.1	0.7	9							
						15.8°C					
Orsat						↓	↓				
0 1111	10					59.9°F	61°F				
						↓					
						60.45°F					
		443°F								1070	0.969
		↓				↓		↓			
		902°R				520.45°R		√Δp			
		Average				Average	Average		Average	Total	
	45					Average		0.071			10.37

.24

STACK SAMPLING FIELD TEST REPORT

PLANT: UNIT F

LOCATION: HAYRIVER

STACK DIA. (In.): 8" (SINGLE WALL) → A_s = 0.349 ft²

DATE: APRIL 23, 1990

TIME (24-HR CLOCK): 1350 - 1435

RUN NUMBER: 9-SOX

OPERATORS: AIKEN - CALBICK

STATIC PRESSURE (In. W.G.): 0

P BAR: 29.48 @ 1355 h (Barometric Press.) (In.HG)

P_{sa}: 29.48 + (0) = 29.48

CP (PITOT COEF): 0.774

ORIFICE METER COEF: 0.969

ΔH @ 1.73 ✓

PROBE LENGTH (FT): 3

NOZZLE DIA. (In): 0.50 → A_n = 0.00873 ft²

LEAK RATE: Before: 629.346 − 629.342 = 0.004 Cu.Ft/Min.

After: 641.397 − 641.395 = 0.002 Cu.Ft/Min.

45° 175 .954 .934

1½ hr DELAY

153 157

R. ANGUS

SILICA GEL: 1241.0 − 1237.4 = 3.6 G

1st IMPINGER: 126 − 100 = 26 G

2nd IMPINGER: 104 − 100 = 4 G

3rd IMPINGER: 1 − 0 = 1 G

4th IMPINGER: H_2O_2 102 − 100 = 2 G

5th IMPINGER: H_2O_2 101 − 100 = 1 G

V_{lc} = 37.6

FILTER NUMBER: 512

FILTER: (#4) 1.1756 − 1.1465 = 0.0291 g NAS

PROBE & CYCLONE WASHES: 55.076 − 55.060 = 0.016 g NAS

WEIGHT: (gs) m_3 SO_2: 159.1 SO_3: ____ H_2SO_4: ____

ASH SAMPLE (BEFORE) M: 0.0451 g

PARTICULATE SAMPLING DATA

Sampling Point Number	Clock Time	Stack Gas Temp (°F) Ts	Probe Temp (°F)	Impinger Outlet Temp (°F)	Dry Gas Meter Temp (°F)	Dry Gas Meter Temp (°F)	Velocity Head (In. wg.) ΔP	Orifice Meter (In. wg.) ΔH	Gas Meter Volume (Ft.³)	Pump Vacuum (In. Hg.)
	0								629.098	
1	5	575	290	49	16	62	0.083	0.25	630.96	2
2	10	586	299	49	16	62	.008	.25	633.88	2
3	15	594	290	49	15.5	61	.008	.25	636.09	2
4	20	595	290	50	15.5	61	.008	.25	638.4	2
5	25	591	290	49	15.5	61	.008	.25	635.7	2
6	30	587	291	49	15.5	61	.008	.25	637.21	2
7	35	583	290	49	15.5	61	.008	.25	638.6	2
8	40	580	290	49	15.5	61	.008	.25	640.14	2
9	45	581	291	49	15.5	61	.008	.25	641.58	2
		NOVA SN		CO			Orifice			
1407	19.9	20.0	-0.3	250ppm			1.41	10	(gain unid	
1420	20.0	19.9	-0.7	40			1.43	<10		
1427	20.1	19.9	-0.7	46						
					19.6°C					
					60.1°F	61.2°F				
		586°F			60.65°F		ΔP		12.535	X0.969
		1046°R			530.65°R					
	45	Ts			Tm	Tm	0.083	ΔH	Vm	12.15

.28

STACK SAMPLING FIELD TEST REPORT

PLANT: UNIT A

LOCATION: YELLOWKNIFE

STACK DIA. (In.): 6

DATE: APRIL 18, 1990

TIME (24-HR CLOCK): 1235 - 1338 h

RUN NUMBER: 1-NOX

OPERATORS: AIKEN - CALBICK

STATIC PRESSURE (In.W.G.): 0

P BAR: 2900 @ 0900 (Barometric Press.) +( ) (In.HG) = 29.00

CP (PITOT COEF): 0.874

ORIFICE METER COEF: 1.036

ΔH @ —

PROBE LENGTH (FT): 3

NOZZLE DIA. (In): 1/4

LEAK RATE: Before: - .1 Cu.Ft/Min.

After: - Cu.Ft/Min.

L

125
136
136
15
412 ml

SILICA GEL: - / G

1st IMPINGER: - 100 G

2nd IMPINGER: - 10.5 G

3rd IMPINGER: - 0 G

4th IMPINGER: - / G

5th IMPINGER: - / G

FILTER NUMBER:

FILTER: - MG

PROBE & CYCLONE WASHES: - MG

WEIGHT: (G)
SO_2 ____ SO_3 ____ H_2SO_4 ____

(.412 L)(3.04 mg N/L) = 1.25 mg N
= (1.25)(46/14) = (1.25)(3.286) = 4.11 mg NO_2

PARTICULATE SAMPLING DATA

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (In. wg.)	Orifice Meter (In. wg.)	Gas Meter Volume (TEMP) L	Pump Vacuum (In. Hg.)
	0									1494.962	
	1305					66				1503.15	
	1338					66				1516.415	
						526°R				16.453	1.036
		Average				Average	Average		Average	Total	16.54 L

STACK SAMPLING FIELD TEST REPORT

PLANT: UNIT A

LOCATION: YELLOWKNIFE

STACK DIA. (In.): 6

DATE: APRIL 18, 1990

TIME (24-HR CLOCK): 1436-1536

RUN NUMBER: 2-NOx

OPERATORS: AIKEN - CALBICK

STATIC PRESSURE (In.W.G.): 148

P BAR: (Barometric Press.) (In.HG) 140

144

____ + ( ) = ____

CP (PITOT COEF): 0.774

ORIFICE METER COEF: 1.006

ΔH@ —

PROBE LENGTH (FT): 3

NOZZLE DIA. (In): 1/4

LEAK RATE: Before: — O.K. Cu.Ft/Min.

After: — Cu.Ft/Min.

SILICA GEL: — G

1st IMPINGER: — 100 G

2nd IMPINGER: — 10.0 G

3rd IMPINGER: — 0 G

4th IMPINGER: — / G

5th IMPINGER: — G

FILTER NUMBER:

FILTER: — MG

PROBE & CYCLONE WASHES: — MG

WEIGHT: (G)

SO_2: ____ SO_3: ____ H_2SO_4 ____

432 ml.

$(0.432\ l)\left(1.52\ \frac{mg\ N}{l}\right) = 0.657\ mg\ N\left(\frac{46}{14}\frac{NO_2}{N}\right) = 2.16\ mg\ NO_2$

PARTICULATE SAMPLING DATA

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (In. wg.)	Orifice Meter (In. wg.)	Gas Meter Volume (Ft.³)	Pump Vacuum (In. wg.)
	0									154.052	
	1452					64				159.221	
	1508					64				163.931	
	1536					64				168.151	
						534°R					
										32.030 X	1.006
		Average				Total	Total		Total	Total	32.29

STACK SAMPLING FIELD TEST REPORT

PLANT: UNIT A

LOCATION: YELLOWKNIFE

STACK DIA. (In.): 6

DATE: APRIL 19, 1990

TIME (24-HR CLOCK): 1049 - 1150

RUN NUMBER: 3 NO_x

OPERATORS: AIKEN - CALBICK

STATIC PRESSURE (In.W.G.): _____

P BAR: (Barometric Press.) (In.HG)

_____ + ( ) = _____

CP (PITOT.COEF): 0.834

ORIFICE METER COEF: 1.006

ΔH@ _____

PROBE LENGTH (FT): 3

NOZZLE DIA. (In): 1/4

LEAK RATE: Before: _____

OK

Cu.Ft/Min.

After: _____

Cu.Ft/Min.

167
236
70
473ml

6" DIA

$(0.473l)(0.80 \frac{mgN}{l})\left(\frac{96}{14}\frac{NO_x}{N}\right) = 1.24\ mg\ NO_2$

SILICA GEL: _____ G

1st IMPINGER: 100 G

2nd IMPINGER: 100 G

3rd IMPINGER: 0 G

4th IMPINGER: / G

5th IMPINGER: / G

FILTER NUMBER: _____

FILTER: _____ MG

PROBE & CYCLONE WASHES: _____ MG

WEIGHT: (G)

SO_2: ____ SO_3: ____ H_2SO_4 ____

L _____

PARTICULATE SAMPLING DATA

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (In. wg.)	Orifice Meter (In. wg.)	Gas Meter Volume (Ft.³)	Pump Vacuum (In. Hg.)
	0									1547.742	
	1103					56				1556.12	
	1129					60				1561.11	
	1139					61				1565.39	
	1150					62				1572.242	
						59.78°F				24.63 X	1.0
						59.78°F					
		Average				Average	Average		Average	Total	24.63

STACK SAMPLING FIELD TEST REPORT

PLANT: UNIT 8

LOCATION: YELLOWKNIFE

STACK DIA. (in.): 6

DATE: APRIL 19, 1990

TIME (24-HR CLOCK): 1254-1354

RUN NUMBER: 4 - NOx

OPERATORS: AIKEN - CALBICK

STATIC PRESSURE (in.W.G.): _____

P BAR: _____ (Barometric Press.) + (_____) = _____ (in.HG)

CP (PITOT.COEF): 0.874

ORIFICE METER COEF: 1.006

ΔH @ _____

PROBE LENGTH (FT): 3

NOZZLE DIA. (in): 1/4

LEAK RATE: Before: _____ - OK _____ Cu.Ft/Min.

After: _____ - _____ Cu.Ft/Min.

L = _____

173
194
101
468 ml

6" DIA

$(0.468\,l)\left(1.44 \frac{mg\,N}{l}\right)\left(\frac{46}{14}\frac{NO_2}{N}\right) = 2.21\ mg\ NO_2$

SILICA GEL: _____ - _____ G

1st IMPINGER: _____ - 100 G

2nd IMPINGER: _____ - 10.5 G

3rd IMPINGER: _____ - 0 G

4th IMPINGER: _____ - / G

5th IMPINGER: _____ - / G

FILTER NUMBER: _____

FILTER: _____ - _____ MG

PROBE & CYCLONE WASHES: _____ - _____ MG

WEIGHT: (G)

SO_2: _____ SO_3: _____ H_2SO_4: _____

PARTICULATE SAMPLING DATA

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Reading (ft.³)	Pump Vacuum (in. Hg.)
	0									1537.035	
	1309					69				1549.86	
	1326					70				1386.02	
	1336					70				1573.39	
	1354					71				1603.308	
						530°R				33.933X	1.00L
		Temp				Inlet Temp	Outlet Temp		Temp	Total	32.98

STACK SAMPLING FIELD TEST REPORT

PLANT: UNIT C

LOCATION: YELLOWKNIFE

STACK DIA. (In.): 7

DATE: APRIL 20, 1990

TIME (24-HR CLOCK): 1109 - 1153

RUN NUMBER: 5-NOX

OPERATORS: AIKEN - CALBICK

STATIC PRESSURE (In.W.G.): _____

P BAR: _____ (Barometric Press.) _____ (In.HG)

CP (PITOT.COEF): 0.774

ORIFICE METER COEF: 1.006

ΔH @ _____

PROBE LENGTH (FT): 3

NOZZLE DIA. (In): 1/4

LEAK RATE: Before: OK Cu.Ft/Min.

After: _____ Cu.Ft/Min.

L _____

176
236
84
496 ml

SILICA GEL: _____ G

1st IMPINGER: 100 G

2nd IMPINGER: 10.0 G

3rd IMPINGER: 0 G

4th IMPINGER: / G

5th IMPINGER: / G

$(0.4962)\left(2.40 \frac{mg\ N}{l}\right)\left(\frac{46\ NO_2}{14\ N}\right) = 3.81\ mg\ NO_2$

FILTER NUMBER: _____

FILTER: _____ MG

PROBE & CYCLONE WASHES: _____ MG

WEIGHT: (G)
SO_2: ____ SO_3: ____ H_2SO_4 ____

PARTICULATE SAMPLING DATA

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (In. wg.)	Orifice Meter (In. wg.)	Gas Meter Volume (Ft.³)	Pump Vacuum (In. Hg.)
	0									1162.859	
	1140					61				1630.93	2.5
	1146					61				1636.58	5.5
	1151					61				1638.60	6.0
	1153					61				1639.29	6.0
						521°R				33.295	1.006
		Factor				Factor	Factor		Factor	Total	33.59

STACK SAMPLING FIELD TEST REPORT

PLANT: UNIT D

LOCATION: HAYRIVER

STACK DIA. (In.): 3

DATE: APRIL 22, 1990

TIME (24-HR CLOCK): 1119-1213

RUN NUMBER: 6 - NO_x

OPERATORS: AIKEN - CALBICK

STATIC PRESSURE (In. W.G.): 29.25 @ 1003

P BAR: ____ + (____) - ____ (Barometric Press.) (In.HG)

CP (PITOT.COEF): 0.274

ORIFICE METER COEF: 1.006

ΔH @ ____

PROBE LENGTH (FT): 3

NOZZLE DIA. (In): 1/4

LEAK RATE: Before: - OK Cu. Ft/Min.

After: - ____ Cu. Ft/Min.

L ____

202
192
208
602 ml

SILICA GEL: ____ - ____ G

1st IMPINGER: ____ - 102 G

2nd IMPINGER: ____ - 10.1 G

3rd IMPINGER: ____ $(0.602\,l)\left(3.28\frac{mg}{l}\right)\left(\frac{46}{14}\frac{NO_2}{N}\right) = 6.49$ mg NO_2 U - ____ G

4th IMPINGER: ____ - / G

5th IMPINGER: ____ - ____ G

FILTER NUMBER: ____

FILTER: ____ - ____ MG

PROBE & CYCLONE WASHES: ____ - ____ MG

WEIGHT: (G) SO_2: ____ SO_3: ____ H_2SO_4 ____

PARTICULATE SAMPLING DATA

1636.1

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (In. wg.)	Orifice Meter (In. wg.)	Gas Meter Volume (Ft.³)	Pump Vacuum (In. wg.)
	0									163661	
	1132					56				165121	
	1142					57				166768	
	1217					60				170959	
						↓				↓	
						57.67				73.19 X	1.006
						↓					
						57.67					
		Temp				Temp	Temp		Temp	Temp	73.59

STACK SAMPLING FIELD TEST REPORT

PLANT: UNIT D

LOCATION: HAYRIVER

STACK DIA. (In.): 8

DATE: APRIL 22, 1990

TIME (24-HR CLOCK): 1245 - 1340

RUN NUMBER: 7 NOx

OPERATORS: AIKEN - CALBICK

STATIC PRESSURE (In. W.G.): _____

P BAR: _____ (Barometric Press.) + (_____) = _____ (In.HG)

CP (PITOT COEF): 0.874

ORIFICE METER COEF: 1.006

ΔH@ : —

PROBE LENGTH (FT): 3

NOZZLE DIA. (In): 1/4

LEAK RATE: Before: _____ - O.K. _____ Cu. Ft/Min.

After: _____ - _____ Cu. Ft/Min.

241
178
419 ml

SILICA GEL: _____ - _____ G

1st IMPINGER: _____ - 100 G

2nd IMPINGER: _____ - 10.5 G

3rd IMPINGER: _____ - 0 G

4th IMPINGER: _____ - _____ G

$(0.9101)\left(5.60 \frac{mg\,N}{ml}\right)\left(\frac{46}{14}\frac{NO_2}{N}\right) = 7.71 mg\ NO_2$

5th IMPINGER: _____ - _____ G

FILTER NUMBER: _____

FILTER: _____ - _____ MG

PROBE & CYCLONE WASHES: _____ - _____ MG

WEIGHT: (G)
SO_2: _____ SO_3: _____ H_2SO_4 _____

PARTICULATE SAMPLING DATA

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (In. wg.)	Orifice Meter (In. wg.)	Gas Meter Volume (FT.³)	Pump Vacuum (In. wg.)
	0									1321.88	
	1255					62				1327.39	
	1300					62				1333.18	
	1320					62				1386.53	
	1340					62				1389.030	
						522°R				67.548 X	1.006
											68.36

STACK SAMPLING FIELD TEST REPORT

PLANT: UNIT E

LOCATION: HAYRIVER

STACK DIA. (In.): 8

DATE: APRIL 23, 1990

TIME (24-HR CLOCK): 0941 - 1031

RUN NUMBER: B NOx

OPERATORS: AIKEN - CALBICK

STATIC PRESSURE (In.W.G.): _____

P BAR: _____ (Barometric Press.) + (_____) = _____ (In.HG)

CP (PITOT COEF): 0.274

ORIFICE METER COEF: 1.006

ΔH @ _____

PROBE LENGTH (FT): 3

NOZZLE DIA. (In): 1/4

LEAK RATE: Before: _____ - OK _____ Cu.Ft/Min.

After: _____ - _____ Cu.Ft/Min.

L _____

SILICA GEL: _____ - _____ G

1st IMPINGER: 170 - 100 G

2nd IMPINGER: 154 - 10.5 G

3rd IMPINGER: 155 - 0 G

4th IMPINGER: 479 ml _____ - _____ G

5th IMPINGER: _____ - _____ G

$(0.979l)\left(3.96 \frac{mg\ N}{l}\right)\left(\frac{76\ NO_2}{14\ N}\right) = 6.23\ mg\ NO_2$

FILTER NUMBER: _____

FILTER: _____ - _____ MG

PROBE & CYCLONE WASHES: _____ - _____ MG

WEIGHT: (G)

SO_2: _____ SO_3: _____ H_2SO_4 _____

PARTICULATE SAMPLING DATA

Sampling Point Number	Clock Time	Start Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (In. wg.)	Orifice Meter (In. wg.)	Gas Meter Volume (Ft.³)	Pump Vacuum (In. Hg.)
	0									1789.33	
	1016					66				1830.09	
	1022					66				1835.82	
						66				1844.550	
						521°R				53.179X	1.006
		Average				Average	Average		Average	Total	55.51
						Average					

STACK SAMPLING FIELD TEST REPORT

PLANT: UNIT F

LOCATION: HAYRIVER

STACK DIA. (In.): 8

DATE: APRIL , 1990

TIME (24-HR CLOCK): 1352 - 1437

RUN NUMBER: 9 NOx

OPERATORS: AIKEN - CALBICK

STATIC PRESSURE (In. W.G.): _____

P BAR: _____ (Barometric Press.) + (_____) = _____ (In.HG)

CP (PITOT COEF): 0.874 LANAIR

ORIFICE METER COEF: 1.006 MODEL 220E

ΔH @ _____ IN THRU

PROBE LENGTH (FT): 3 DAMPER (ALL PROBES)

NOZZLE DIA. (In): 1/4 SERIAL 2482

LEAK RATE: Before: _____ 160,000 BTU/HR

- OK Cu. Ft/Min. 1.14 Gal/hr US

After: _____ JANESVILLE WI

- _____ Cu. Ft/Min. 53547

L _____ Lite @1330

150
166
152
468 ml

SILICA GEL: _____ - _____ G

1st IMPINGER: _____ - 100 G

2nd IMPINGER: _____ - 100 G

3rd IMPINGER: _____ - 0 G

4th IMPINGER: _____ - _____ G

$(0.968l)\left(4.38 \frac{mg\ N}{l}\right)\left(\frac{46}{14}\ \frac{NO_2}{N}\right) = 679\ mg\ NO_2$

5th IMPINGER: _____ - _____ G

FILTER NUMBER: _____

FILTER: _____ - _____ MG

PROBE & CYCLONE WASHES: _____ - _____ MG

WEIGHT: (G) SO_2: ____ SO_3: ____ H_2SO_4 ____

PARTICULATE SAMPLING DATA

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (In. wg.)	Orifice Meter (In. wg.)	Gas Meter Volume (Ft.³)	Pump Vacuum (In. Hg.)
	0									1844.559	
	1405					66				1854.64	
	1412					66				1859.42	
	1427					67				1874.24	
	1437					67				1882.879	
						66.5°F				46.34 X	1.006
						526.5°R					
		Temp				Temp	Temp		Temp	Vol	46.62

DRY GAS METER CALIBRATION

e: 05/02/90 Dry Gas Meter No.: BCR -2

ometric pressure, Pb = 30.16 in. Hg Dry Test Meter Correction Factor, Ystd = 0.9953

Orifice anometer Setting in. H2O)	Gas volume dry test meter (cubic ft)	Gas volume dry gas meter (cubic ft)	Temperature (F) Dry test meter	Temperature (F) Dry gas meter	Time (min.)	Y	Delta H @	cfm
0.00	2.754	2.838	68.3	70.4	6.0	0.9697	0.000	0.46
0.00	4.250	4.395	68.3	71.8	6.5	0.9688	0.000	0.65
					Average	0.9693	0.000	

SEE RUNS 1-2 AT YELLOWKNIFE ON APRIL 17, 1990

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 10, 1990

ICP-MS Analysis

Sample Identity : #1 filter
E.R.I. Reference : 142821

Total Element Concentrations [micrograms per litre (ppb)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7	<	1.6	Beryllium	9		0.15
Boron	10		5800	Sodium	23		110000
Magnesium	25		8500	Aluminium	27		6500
Silicon	28		12000	Phosphorus	31		3800
Potassium	39		3800	Calcium	44		26000
Scandium	45		33	Titanium	49		55
Vanadium	51	<	0.02	Chromium	52		260
Manganese	55		500	Iron	56		2700
Cobalt	59		5.0	Nickel	60		170
Copper	63		340	Zinc	66		2500
Gallium	71		2.4	Germanium	74		0.24
Arsenic	75		21	Bromine	79		370
Selenium	77		0.38	Rubidium	85		15
Strontium	88		26	Yttrium	89		0.80
Zirconium	90		26	Niobium	93		0.12
Molybdenum	98		44	Ruthenium	101	<	0.04
Rhodium	103	<	0.02	Silver	107		20
Palladium	105		0.10	Cadmium	111		64
Indium	115		2.9	Tin	120		240
Antimony	121		34	Tellurium	126	<	0.17
Iodine	127		1.2	Caesium	133		0.31
Barium	138		160	Lanthanum	139		1.2
Cerium	140		2.4	Praseodymium	141		0.26
Neodymium	146		0.93	Samarium	149		0.13
Europium	151		0.10	Gadolinium	160		0.15
Terbium	159	<	0.03	Dysprosium	163		0.07
Holmium	165		0.03	Erbium	166		0.07
Thulium	169	<	0.02	Ytterbium	172		0.05
Lutetium	175		int.std	Hafnium	178		0.58
Tantalum	181	<	0.02	Tungsten	184		1.4
Rhenium	185	<	0.02	Osmium	190	<	0.02
Iridium	193		0.03	Platinum	194	<	0.04
Gold	197	<	0.15	Mercury	201		0.32
Thallium	203		0.07	Lead	208		2100
Bismuth	209		5.0	Thorium	232		0.08
Uranium	238		0.08				

int.std = internal standard used

Analyst. Darlene Ty.

142809r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 10, 1990

ICP-MS Analysis

Sample Identity : #2 filter
E.R.I. Reference : 142822

Total Element Concentrations [micrograms per litre (ppb)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7	<	1.6	Beryllium	9		0.23
Boron	10		7700	Sodium	23		6400
Magnesium	25		12000	Aluminium	27		93000
Silicon	28		21000	Phosphorus	31		2900
Potassium	39		4500	Calcium	44		34000
Scandium	45		53	Titanium	49		49
Vanadium	51	<	0.02	Chromium	52		250
Manganese	55		390	Iron	56		2500
Cobalt	59		3.5	Nickel	60		120
Copper	63		330	Zinc	66		2000
Gallium	71		3.2	Germanium	74		0.29
Arsenic	75		19	Bromine	79		590
Selenium	77		2.4	Rubidium	85		18
Strontium	88		34	Yttrium	89		1.0
Zirconium	90		22	Niobium	93		0.27
Molybdenum	98		40	Ruthenium	101	<	0.04
Rhodium	103		0.03	Silver	107		10
Palladium	105		0.23	Cadmium	111		44
Indium	115		1.4	Tin	120		110
Antimony	121		21	Tellurium	126	<	0.17
Iodine	127		1.1	Caesium	133		0.12
Barium	138		170	Lanthanum	139		1.3
Cerium	140		2.7	Praseodymium	141		0.34
Neodymium	146		0.91	Samarium	149		0.27
Europium	151		0.11	Gadolinium	157		0.55
Terbium	159	<	0.03	Dysprosium	163		0.12
Holmium	165		0.02	Erbium	166		0.09
Thulium	169	<	0.02	Ytterbium	172		0.11
Lutetium	175		int.std	Hafnium	178		0.44
Tantalum	181	<	0.02	Tungsten	184		1.4
Rhenium	185	<	0.02	Osmium	190	<	0.02
Iridium	193	<	0.02	Platinum	195		0.06
Gold	197	<	0.15	Mercury	200		1.5
Thallium	205		0.20	Lead	208		1200
Bismuth	209		3.0	Thorium	232		0.11
Uranium	238		0.12				

int.std = internal standard used

Analyst Darlene T.Y.

142809r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 10, 1990

ICP-MS Analysis

Sample Identity : #3 filter
E.R.I. Reference : 142823

Total Element Concentrations [micrograms per litre (ppb)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7	<	1.6	Beryllium	9		0.14
Boron	10		5300	Sodium	23		98000
Magnesium	25		8800	Aluminium	27		6500
Silicon	28		13000	Phosphorus	31		3200
Potassium	39		4200	Calcium	44		29000
Scandium	45		41	Titanium	49		51
Vanadium	51	<	0.02	Chromium	52		410
Manganese	55		140	Iron	56		3300
Cobalt	59		6.4	Nickel	60		240
Copper	63		1200	Zinc	66		4000
Gallium	71		3.3	Germanium	74	<	0.12
Arsenic	75		15	Bromine	79		610
Selenium	77		3.5	Rubidium	85		15
Strontium	88		31	Yttrium	89		0.95
Zirconium	90		18	Niobium	93		0.21
Molybdenum	98		75	Ruthenium	101	<	0.04
Rhodium	103	<	0.02	Silver	107		75
Palladium	105		0.29	Cadmium	111		44
Indium	115		0.35	Tin	120		16
Antimony	121		7.6	Tellurium	126	<	0.17
Iodine	127		1.8	Caesium	133		0.30
Barium	138		160	Lanthanum	139		3.9
Cerium	140		4.4	Praseodymium	141		0.70
Neodymium	146		2.4	Samarium	149		0.31
Europium	151		0.09	Gadolinium	160		0.48
Terbium	159	<	0.03	Dysprosium	163		0.29
Holmium	165		0.03	Erbium	166		0.08
Thulium	169	<	0.02	Ytterbium	172		0.11
Lutetium	175		int.std	Hafnium	178		0.22
Tantalum	181	<	0.02	Tungsten	184		2.8
Rhenium	185	<	0.02	Osmium	190	<	0.02
Iridium	193		0.02	Platinum	194	<	0.04
Gold	197	<	0.15	Mercury	200		2.8
Thallium	205		0.19	Lead	208		810
Bismuth	209		0.96	Thorium	232		0.10
Uranium	238		0.08				

int.std = internal standard used

Analyst Darlene Taylor

142809r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 10, 1990

ICP-MS Analysis

Sample Identity : #4 filter
E.R.I. Reference : 142824

Total Element Concentrations [micrograms per litre (ppb)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7	<	1.6	Beryllium	9		0.13
Boron	10		6700	Sodium	23		130000
Magnesium	25		11000	Aluminium	27		7400
Silicon	28		19000	Phosphorus	31		3700
Potassium	39		4500	Calcium	44		34000
Scandium	45		60	Titanium	49		59
Vanadium	51	<	0.02	Chromium	52		330
Manganese	55		160	Iron	56		3900
Cobalt	59		8.1	Nickel	60		240
Copper	63		360	Zinc	66		3200
Gallium	71		3.0	Germanium	74		0.30
Arsenic	75		19	Bromine	79		580
Selenium	82		2.8	Rubidium	85		18
Strontium	88		35	Yttrium	89		0.92
Zirconium	90		19	Niobium	93		0.11
Molybdenum	98		53	Ruthenium	101	<	0.04
Rhodium	103	<	0.02	Silver	107		28
Palladium	105		0.45	Cadmium	111		23
Indium	115		0.50	Tin	120		56
Antimony	121		17	Tellurium	126	<	0.17
Iodine	127		1.1	Caesium	133		0.34
Barium	138		190	Lanthanum	139		3.0
Cerium	140		3.7	Praseodymium	141		0.64
Neodymium	146		2.0	Samarium	149		0.10
Europium	151		0.15	Gadolinium	160		0.27
Terbium	159	<	0.03	Dysprosium	163		0.16
Holmium	165	<	0.02	Erbium	166		0.14
Thulium	169		0.03	Ytterbium	172		0.08
Lutetium	175		int.std	Hafnium	178		0.38
Tantalum	181	<	0.02	Tungsten	184		1.3
Rhenium	185		0.04	Osmium	190		0.03
Iridium	193	<	0.02	Platinum	194	<	0.04
Gold	197	<	0.15	Mercury	200		15
Thallium	205		0.15	Lead	208		970
Bismuth	209		1.3	Thorium	232		0.10
Uranium	238		0.14				

int.std = internal standard used

Analyst. Barbara Taylor

142809r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 10, 1990

ICP-MS Analysis

Sample Identity : #5 filter
E.R.I. Reference : 142825

Total Element Concentrations [micrograms per litre (ppb)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7	<	1.6	Beryllium	9		0.15
Boron	10		5000	Sodium	23		110000
Magnesium	25		8900	Aluminium	27		6400
Silicon	28		14000	Phosphorus	31		5000
Potassium	39		5200	Calcium	44		33000
Scandium	45		51	Titanium	49		110
Vanadium	51	<	0.02	Chromium	52		620
Manganese	55		250	Iron	56		9600
Cobalt	59		12	Nickel	60		610
Copper	63		680	Zinc	66		6000
Gallium	71		2.8	Germanium	74		0.64
Arsenic	75		180	Bromine	79		860
Selenium	82		11	Rubidium	85		18
Strontium	88		36	Yttrium	89		0.98
Zirconium	90		16	Niobium	93		0.68
Molybdenum	98		200	Ruthenium	101		0.04
Rhodium	103		0.10	Silver	107		13
Palladium	105		0.21	Cadmium	111		160
Indium	115		4.6	Tin	120		80
Antimony	121		28	Tellurium	126	<	0.17
Iodine	127		98	Caesium	133		0.42
Barium	138		130	Lanthanum	139		2.2
Cerium	140		3.8	Praseodymium	141		0.52
Neodymium	146		2.1	Samarium	149		0.25
Europium	151		0.15	Gadolinium	157		0.73
Terbium	159		0.04	Dysprosium	163		0.14
Holmium	165		0.03	Erbium	166		0.08
Thulium	169	<	0.02	Ytterbium	172		0.15
Lutetium	175		int.std	Hafnium	178		0.36
Tantalum	181	<	0.02	Tungsten	184		2.2
Rhenium	185		0.07	Osmium	190	<	0.02
Iridium	193		0.04	Platinum	194		0.13
Gold	197	<	0.15	Mercury	200		7.3
Thallium	205		0.18	Lead	208		4500
Bismuth	209		3.4	Thorium	232		0.20
Uranium	238		0.13				

int.std = internal standard used

Analyst Darlene Typ..

142809r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 10, 1990

ICP-MS Analysis

Sample Identity : #6 filter
E.R.I. Reference : 142826

Total Element Concentrations [micrograms per litre (ppb)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7	<	1.6	Beryllium	9		0.25
Boron	10		6600	Sodium	23		100000
Magnesium	25		9900	Aluminium	27		7000
Silicon	28		17000	Phosphorus	31		3300
Potassium	39		4800	Calcium	44		70000
Scandium	45		60	Titanium	49		50
Vanadium	51	<	0.02	Chromium	52		1200
Manganese	55		440	Iron	56		9700
Cobalt	59		14	Nickel	60		790
Copper	63		990	Zinc	66		8600
Gallium	71		3.0	Germanium	74		0.69
Arsenic	75		52	Bromine	79		390
Selenium	77		3.7	Rubidium	85		18
Strontium	88		53	Yttrium	89		1.2
Zirconium	90		22	Niobium	93		0.45
Molybdenum	98		450	Ruthenium	101		0.11
Rhodium	103	<	0.02	Silver	107		41
Palladium	105		0.26	Cadmium	111		66
Indium	115		0.68	Tin	120		27
Antimony	121		15	Tellurium	126		0.90
Iodine	127		7.6	Caesium	133		0.41
Barium	138		170	Lanthanum	139		2.4
Cerium	140		3.9	Praseodymium	141		0.49
Neodymium	146		1.9	Samarium	149		0.28
Europium	151		0.12	Gadolinium	157		0.50
Terbium	159		0.04	Dysprosium	163		0.12
Holmium	165		0.03	Erbium	166		0.10
Thulium	169	<	0.02	Ytterbium	172		0.13
Lutetium	175		int.std	Hafnium	178		0.45
Tantalum	181	<	0.02	Tungsten	184		3.7
Rhenium	185		0.08	Osmium	190	<	0.02
Iridium	193		0.05	Platinum	194	<	0.04
Gold	197	<	0.15	Mercury	200		1.6
Thallium	205		0.16	Lead	208		1300
Bismuth	209		1.4	Thorium	232		0.09
Uranium	238		0.10				

int.std = internal standard used

Analyst Frankie Tyl.

142809r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 10, 1990

ICP-MS Analysis

Sample Identity : #7 filter
E.R.I. Reference : 142827

Total Element Concentrations [micrograms per litre (ppb)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7	<	1.6	Beryllium	9		0.09
Boron	10		4900	Sodium	23		94000
Magnesium	25		7700	Aluminium	27		6400
Silicon	28		15000	Phosphorus	31		2000
Potassium	39		4200	Calcium	44		25000
Scandium	45		43	Titanium	49		32
Vanadium	51	<	0.02	Chromium	52		350
Manganese	55		140	Iron	56		3600
Cobalt	59		6.2	Nickel	60		250
Copper	63		460	Zinc	66		1200
Gallium	71		2.2	Germanium	74	<	0.12
Arsenic	75		17	Bromine	79		260
Selenium	82		2.1	Rubidium	85		14
Strontium	88		25	Yttrium	89		0.75
Zirconium	90		27	Niobium	93		0.15
Molybdenum	98		150	Ruthenium	101	<	0.04
Rhodium	103	<	0.02	Silver	107		9.6
Palladium	105		0.23	Cadmium	111		28
Indium	115		0.44	Tin	120		14
Antimony	121		7.7	Tellurium	126		0.19
Iodine	127		2.4	Caesium	133		0.35
Barium	138		130	Lanthanum	139		2.0
Cerium	140		3.2	Praseodymium	141		0.20
Neodymium	146		0.80	Samarium	149		0.17
Europium	151		0.08	Gadolinium	157		0.15
Terbium	159	<	0.03	Dysprosium	163		0.07
Holmium	165	<	0.02	Erbium	166		0.07
Thulium	169	<	0.02	Ytterbium	172		0.16
Lutetium	175		int.std	Hafnium	178		0.26
Tantalum	181	<	0.02	Tungsten	184		2.3
Rhenium	185		0.02	Osmium	190	<	0.02
Iridium	193		0.05	Platinum	194	<	0.04
Gold	197	<	0.15	Mercury	200		1.7
Thallium	205		0.11	Lead	208		530
Bismuth	209		0.67	Thorium	232		0.08
Uranium	238		0.11				

int.std = internal standard used

Analyst. Darlene Taylor

142809r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 10, 1990

ICP-MS Analysis

Sample Identity : #8 filter
E.R.I. Reference : 142828

Total Element Concentrations [micrograms per litre (ppb)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7	<	1.6	Beryllium	9		0.10
Boron	10		3800	Sodium	23		82000
Magnesium	25		5200	Aluminium	27		4900
Silicon	28		9200	Phosphorus	31		2100
Potassium	39		3500	Calcium	44		20000
Scandium	45		29	Titanium	49		33
Vanadium	51	<	0.02	Chromium	52		800
Manganese	55		190	Iron	56		5000
Cobalt	59		12	Nickel	60		750
Copper	63		650	Zinc	66		2000
Gallium	71		2.1	Germanium	74	<	0.12
Arsenic	75		12	Bromine	79		200
Selenium	82		3.9	Rubidium	85		11
Strontium	88		29	Yttrium	89		0.60
Zirconium	90		20	Niobium	93		0.40
Molybdenum	98		230	Ruthenium	101	<	0.04
Rhodium	103		0.03	Silver	107		19
Palladium	105	<	0.05	Cadmium	111		61
Indium	115		0.49	Tin	120		84
Antimony	121		14	Tellurium	126	<	0.17
Iodine	127		1.5	Caesium	133		0.21
Barium	138		560	Lanthanum	139		1.1
Cerium	140		2.4	Praseodymium	141		0.29
Neodymium	146		0.95	Samarium	149		0.08
Europium	151		0.26	Gadolinium	160		0.11
Terbium	159	<	0.03	Dysprosium	163		0.04
Holmium	165		0.02	Erbium	166		0.10
Thulium	169	<	0.02	Ytterbium	172		0.03
Lutetium	175		int.std	Hafnium	178		0.41
Tantalum	181	<	0.02	Tungsten	184		2.1
Rhenium	185	<	0.02	Osmium	190	<	0.02
Iridium	193	<	0.02	Platinum	194	<	0.04
Gold	197	<	0.15	Mercury	200		1.9
Thallium	205		0.03	Lead	208		930
Bismuth	209		1.4	Thorium	232		0.05
Uranium	238		0.08				

int.std = internal standard used

Analyst. Wanless, T.J.

142809r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 10, 1990

ICP-MS Analysis

Sample Identity : #9 filter
E.R.I. Reference : 142829

Total Element Concentrations [micrograms per litre (ppb)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7	<	1.6	Beryllium	9		0.09
Boron	10		3500	Sodium	23		80000
Magnesium	25		5800	Aluminium	27		5300
Silicon	28		12000	Phosphorus	31		2800
Potassium	39		4000	Calcium	44		33000
Scandium	45		35	Titanium	49		46
Vanadium	51		0.95	Chromium	52		580
Manganese	55		230	Iron	56		4400
Cobalt	59		12	Nickel	60		480
Copper	63		650	Zinc	66		2900
Gallium	71		2.1	Germanium	74	<	0.12
Arsenic	75		15	Bromine	79		880
Selenium	82		11	Rubidium	85		12
Strontium	88		31	Yttrium	89		0.56
Zirconium	90		20	Niobium	93		0.30
Molybdenum	98		84	Ruthenium	101	<	0.04
Rhodium	103		0.06	Silver	107		17
Palladium	105		0.12	Cadmium	111		62
Indium	115		0.44	Tin	120		96
Antimony	121		16	Tellurium	126	<	0.17
Iodine	127		1.7	Caesium	133		0.25
Barium	138		85	Lanthanum	139		4.1
Cerium	140		2.8	Praseodymium	141		0.76
Neodymium	146		1.8	Samarium	149		0.20
Europium	151		0.05	Gadolinium	160		0.11
Terbium	159	<	0.03	Dysprosium	163	<	0.04
Holmium	165	<	0.02	Erbium	166		0.09
Thulium	169	<	0.02	Ytterbium	172		0.10
Lutetium	175		int.std	Hafnium	178		0.48
Tantalum	181	<	0.02	Tungsten	184		1.6
Rhenium	185		0.02	Osmium	190	<	0.02
Iridium	193	<	0.02	Platinum	194	<	0.04
Gold	197	<	0.15	Mercury	200		1.9
Thallium	205		0.10	Lead	208		930
Bismuth	209		2.1	Thorium	232		0.07
Uranium	238		0.06				

int.std = internal standard used

Analyst Barbara Tyc.

142809r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 10, 1990

ICP-MS Analysis

Sample Identity : #10 blank
E.R.I. Reference : 142830

Total Element Concentrations [micrograms per litre (ppb)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7	<	1.6	Beryllium	9		0.12
Boron	10		2700	Sodium	23		79000
Magnesium	25		5400	Aluminium	27		5200
Silicon	28		6800	Phosphorus	31		670
Potassium	39		4000	Calcium	44		18000
Scandium	45		16	Titanium	49		20
Vanadium	51	<	0.02	Chromium	52		4.7
Manganese	55		15	Iron	56		440
Cobalt	59		0.62	Nickel	60		15
Copper	63		120	Zinc	66		64
Gallium	71		2.3	Germanium	74	<	0.12
Arsenic	75	<	0.02	Bromine	79		26
Selenium	78	<	0.60	Rubidium	85		11
Strontium	88		15	Yttrium	89		0.95
Zirconium	90		29	Niobium	93		0.34
Molybdenum	98		0.22	Ruthenium	101	<	0.04
Rhodium	103	<	0.02	Silver	107		1.7
Palladium	105	<	0.07	Cadmium	111		0.52
Indium	115		0.05	Tin	120		1.7
Antimony	121		0.45	Tellurium	126	<	0.17
Iodine	127		0.46	Caesium	133		0.16
Barium	138		52	Lanthanum	139		0.61
Cerium	140		1.2	Praseodymium	141		0.14
Neodymium	146		0.53	Samarium	147		0.14
Europium	151		0.14	Gadolinium	160		0.04
Terbium	159	<	0.03	Dysprosium	163		0.07
Holmium	165		0.02	Erbium	166		0.15
Thulium	169	<	0.02	Ytterbium	172		0.12
Lutetium	175		int.std	Hafnium	178		0.69
Tantalum	181	<	0.02	Tungsten	184		0.33
Rhenium	185	<	0.02	Osmium	190	<	0.02
Iridium	193		0.06	Platinum	194		0.07
Gold	197	<	0.15	Mercury	200		0.16
Thallium	205		0.03	Lead	208		24
Bismuth	209		0.05	Thorium	232		0.08
Uranium	238		0.12				

int.std = internal standard used

Analyst. L. Warren Typ.

142809r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 11, 1990

ICP-MS Analysis

Sample Identity : #17 run 1,2 oil
E.R.I. Reference : 14301

Total Element Concentrations [micrograms per litre (ppb)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7		1500	Beryllium	9	<	0.8
Boron	10		10000	Sodium	23		86000
Magnesium	25		520000	Aluminium	27		21000
Silicon	28		24000	Phosphorus	31		940000
Potassium	39		66000	Calcium	43		380000
Scandium	45		120	Titanium	49		1900
Vanadium	51		not.det	Chromium	52		7400
Manganese	55	>	140000	Iron	57		390000
Cobalt	59		70	Nickel	62		2800
Copper	63		22000	Zinc	66		910000
Gallium	69		58	Germanium	74		40
Arsenic	75		not.det	Bromine	79	<	340
Selenium	82	<	42	Rubidium	85		26
Strontium	88		1100	Yttrium	89		7.0
Zirconium	90		46	Niobium	93		9.5
Molybdenum	98		8300	Ruthenium	102		4.5
Rhodium	103		31	Silver	107		24
Palladium	105		33	Cadmium	111		4100
Indium	115		97	Tin	120		11000
Antimony	121		6900	Tellurium	126		13
Iodine	127		11	Caesium	133	<	0.8
Barium	138		3400	Lanthanum	139		6.8
Cerium	140		14	Praseodymium	141		2.0
Neodymium	143		3.0	Samarium	149	<	2.0
Europium	153		1.5	Gadolinium	157	<	2.6
Terbium	159	<	0.6	Dysprosium	163	<	0.7
Holmium	165	<	0.6	Erbium	166		0.9
Thulium	169	<	0.6	Ytterbium	172		1.2
Lutetium	175		int.std	Hafnium	178	<	0.9
Tantalum	181	<	0.6	Tungsten	184		7.8
Rhenium	185	<	0.8	Osmium	190		0.8
Iridium	193	<	0.9	Platinum	194	<	1.9
Gold	197	<	11	Mercury	200	<	3.2
Thallium	205		2.7	Lead	208		230000
Bismuth	209		54	Thorium	232		1.2
Uranium	238		3.3				

not.det = not determined
int.std = internal standard used

Analyst. Darlene Tyl

143009r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 11, 1990

ICP-MS Analysis

Sample Identity : #18 run 3,4 oil
E.R.I. Reference : 14302

Total Element Concentrations [micrograms per litre (ppb)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7		1900	Beryllium	9		1.9
Boron	10		36000	Sodium	23		46000
Magnesium	25		690000	Aluminium	27		11000
Silicon	28		23000	Phosphorus	31		1000000
Potassium	39		28000	Calcium	43		450000
Scandium	45		230	Titanium	49		3700
Vanadium	51		not.det	Chromium	52		4000
Manganese	55		45000	Iron	56		96000
Cobalt	59		63	Nickel	62		750
Copper	63		32000	Zinc	66		1000000
Gallium	71		42	Germanium	74		36
Arsenic	75		not.det	Bromine	79	<	340
Selenium	82	<	42	Rubidium	85		21
Strontium	88		1400	Yttrium	89		25
Zirconium	90		63	Niobium	93	<	2.3
Molybdenum	98		3600	Ruthenium	102		6.3
Rhodium	103		43	Silver	107		19
Palladium	106		28	Cadmium	111		900
Indium	115		180	Tin	120		2900
Antimony	121		840	Tellurium	126		6.4
Iodine	127	<	3.5	Caesium	133		0.9
Barium	138		6300	Lanthanum	139		47
Cerium	140		80	Praseodymium	141		10
Neodymium	143		37	Samarium	149	<	2.0
Europium	151		2.6	Gadolinium	160		3.5
Terbium	159		0.6	Dysprosium	163		2.8
Holmium	165		0.9	Erbium	166		3.0
Thulium	169		0.6	Ytterbium	172		4.9
Lutetium	175		int.std	Hafnium	178		1.9
Tantalum	181	<	0.6	Tungsten	184		5.3
Rhenium	185	<	0.8	Osmium	190	<	0.7
Iridium	193	<	0.9	Platinum	194		2.5
Gold	197	<	11	Mercury	200		6.1
Thallium	205		1.6	Lead	208		200000
Bismuth	209		55	Thorium	232		26
Uranium	238		7.3				

not.det = not determined
int.std = internal standard used

Analyst. Darlene Ty.

143009r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 11, 1990

ICP-MS Analysis

Sample Identity : #19 run 5 oil
E.R.I. Reference : 14303

Total Element Concentrations [micrograms per litre (ppb)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7		2300	Beryllium	9	<	0.8
Boron	10		9300	Sodium	23		78000
Magnesium	25		430000	Aluminium	27		15000
Silicon	28		31000	Phosphorus	31		1100000
Potassium	39		67000	Calcium	44		650000
Scandium	45		270	Titanium	49		1700
Vanadium	51		not.det	Chromium	52		5000
Manganese	55		34000	Iron	56		170000
Cobalt	59		130	Nickel	62		1300
Copper	63		54000	Zinc	66		990000
Gallium	71		19	Germanium	74	<	19
Arsenic	75		not.det	Bromine	79	<	340
Selenium	82	<	42	Rubidium	85		36
Strontium	88		1600	Yttrium	89		11
Zirconium	90		39	Niobium	93		5.7
Molybdenum	98		12000	Ruthenium	102	<	4.0
Rhodium	103		49	Silver	107		43
Palladium	104		41	Cadmium	111		1600
Indium	115		540	Tin	120		6100
Antimony	121		16000	Tellurium	126		7.8
Iodine	127	<	3.5	Caesium	133		1.7
Barium	138		6000	Lanthanum	139		13
Cerium	140		21	Praseodymium	141		4.7
Neodymium	145		8.9	Samarium	149	<	2.0
Europium	151	<	0.9	Gadolinium	160		6.5
Terbium	159	<	0.6	Dysprosium	163		1.6
Holmium	165	<	0.6	Erbium	166		1.2
Thulium	169	<	0.6	Ytterbium	172		1.5
Lutetium	175		int.std	Hafnium	178	<	0.9
Tantalum	181	<	0.6	Tungsten	184		25
Rhenium	185	<	0.8	Osmium	190	<	0.7
Iridium	193	<	0.9	Platinum	194	<	1.9
Gold	197	<	11	Mercury	202		7.5
Thallium	203		4.1	Lead	208		200000
Bismuth	209		41	Thorium	232		3.0
Uranium	238		5.1				

not.det = not determined
int.std = internal standard used

Analyst. Marlene Ty..

143009r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 11, 1990

ICP-MS Analysis

Sample Identity : #20 run 6,7 oil
E.R.I. Reference : 14304

Total Element Concentrations [micrograms per litre (ppb)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7		2400	Beryllium	9	<	0.8
Boron	10		24000	Sodium	23		27000
Magnesium	25		520000	Aluminium	27		7000
Silicon	28		19000	Phosphorus	31		890000
Potassium	39		39000	Calcium	43		540000
Scandium	45		290	Titanium	49		1900
Vanadium	51		not.det	Chromium	52		1900
Manganese	55		22000	Iron	56		79000
Cobalt	59		81	Nickel	62		290
Copper	63		52000	Zinc	66		800000
Gallium	71	<	9.0	Germanium	74	<	19
Arsenic	75		not.det	Bromine	79	<	340
Selenium	82	<	42	Rubidium	85		9.4
Strontium	88		760	Yttrium	89		8.9
Zirconium	90		29	Niobium	93	<	2.3
Molybdenum	98		6300	Ruthenium	102		7.8
Rhodium	103		48	Silver	107		62
Palladium	106		6.0	Cadmium	111		690
Indium	115		100	Tin	120		3100
Antimony	121		1400	Tellurium	126		6.1
Iodine	127	<	3.5	Caesium	133	<	0.8
Barium	138		2200	Lanthanum	139		2.9
Cerium	140		11	Praseodymium	141		3.0
Neodymium	142	<	1.6	Samarium	149		2.1
Europium	151		1.3	Gadolinium	160		2.7
Terbium	159	<	0.6	Dysprosium	161	<	0.8
Holmium	165	<	0.6	Erbium	166		0.7
Thulium	169	<	0.6	Ytterbium	172		0.8
Lutetium	175		int.std	Hafnium	178	<	0.9
Tantalum	181		4.4	Tungsten	184		3.5
Rhenium	185		0.8	Osmium	190	<	0.7
Iridium	193	<	0.9	Platinum	194	<	1.9
Gold	197	<	11	Mercury	200		16
Thallium	205	<	1.2	Lead	208		61000
Bismuth	209		41	Thorium	232		2.2
Uranium	238		2.1				

not.det = not determined
int.std = internal standard used

Analyst Marlene Ty.

143009r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 11, 1990

ICP-MS Analysis

Sample Identity : #21 run 8 oil
E.R.I. Reference : 14305

Total Element Concentrations [micrograms per litre (ppb)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7		3200	Beryllium	9		0.9
Boron	10		16000	Sodium	23		33000
Magnesium	25		380000	Aluminium	27		6500
Silicon	28		14000	Phosphorus	31		760000
Potassium	39		44000	Calcium	43		380000
Scandium	45		300	Titanium	49		2900
Vanadium	51		not.det	Chromium	52		1100
Manganese	55		23000	Iron	56		71000
Cobalt	59		93	Nickel	62		270
Copper	63		30000	Zinc	66		550000
Gallium	71		18	Germanium	74		57
Arsenic	75		not.det	Bromine	79	<	340
Selenium	82	<	42	Rubidium	85		16
Strontium	88		740	Yttrium	89		23
Zirconium	91		38	Niobium	93	<	2.3
Molybdenum	98		2400	Ruthenium	102		18
Rhodium	103		41	Silver	107		44
Palladium	106		22	Cadmium	111		820
Indium	115		23	Tin	120		2100
Antimony	121		670	Tellurium	126	<	6.2
Iodine	127		13	Caesium	133	<	0.8
Barium	138		2800	Lanthanum	139		24
Cerium	140		46	Praseodymium	141		6.8
Neodymium	146		2.4	Samarium	149	<	2.0
Europium	151		1.9	Gadolinium	157	<	2.6
Terbium	159		0.7	Dysprosium	161		2.6
Holmium	165	<	0.6	Erbium	166	<	0.6
Thulium	169	<	0.6	Ytterbium	172		3.4
Lutetium	175		int.std	Hafnium	178		1.8
Tantalum	181	<	0.6	Tungsten	184		2.1
Rhenium	185	<	0.8	Osmium	190	<	0.7
Iridium	193	<	0.9	Platinum	194	<	1.9
Gold	197	<	11	Mercury	200	<	3.2
Thallium	203		3.0	Lead	208		69000
Bismuth	209		10	Thorium	232		13
Uranium	238		3.3				

not.det = not determined
int.std = internal standard used

Analyst. Darlene Tyl

143009r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 11, 1990

ICP-MS Analysis

Sample Identity : #22 run 9 oil
E.R.I. Reference : 14306

Total Element Concentrations [micrograms per litre (ppb)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7		3400	Beryllium	9	<	0.8
Boron	10		7100	Sodium	23		71000
Magnesium	25		400000	Aluminium	27		11000
Silicon	28		18000	Phosphorus	31		820000
Potassium	39		77000	Calcium	43		430000
Scandium	45		490	Titanium	49		7500
Vanadium	51		not.det	Chromium	52		4400
Manganese	55		95000	Iron	56		120000
Cobalt	59		190	Nickel	62		1500
Copper	63		35000	Zinc	66		700000
Gallium	71		41	Germanium	74		190
Arsenic	75		not.det	Bromine	79	<	340
Selenium	82	<	42	Rubidium	85		34
Strontium	88		1300	Yttrium	89		16
Zirconium	90		48	Niobium	93		4.4
Molybdenum	98		4000	Ruthenium	102		18
Rhodium	103		58	Silver	107		30
Palladium	106		27	Cadmium	111		1000
Indium	115		67	Tin	120		5200
Antimony	121		1500	Tellurium	126		6.4
Iodine	127		15	Caesium	133		2.1
Barium	138		7700	Lanthanum	139		23
Cerium	140		38	Praseodymium	141		4.0
Neodymium	142		17	Samarium	149	<	2.0
Europium	153		2.5	Gadolinium	157	<	2.6
Terbium	159		1.6	Dysprosium	163		3.3
Holmium	165		0.8	Erbium	166	<	0.6
Thulium	169	<	0.6	Ytterbium	172		7.1
Lutetium	175		int.std	Hafnium	178	<	0.9
Tantalum	181	<	0.6	Tungsten	184		6.9
Rhenium	185	<	0.8	Osmium	190	<	0.7
Iridium	193	<	0.9	Platinum	194	<	1.9
Gold	197	<	11	Mercury	200	<	3.2
Thallium	203		7.9	Lead	208		300000
Bismuth	209		60	Thorium	232		13
Uranium	238		1.7				

not.det = not determined
int.std = internal standard used

Analyst. D. Clarke Ph.

143009r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 14, 1990

ICP-MS Analysis

Sample Identity : #11 run 1,2 ash
E.R.I. Reference : 1429a1

Total Element Concentrations [micrograms per gram (ppm)]

ELEMENT	MASS	CONC	ELEMENT	MASS	CONC
Lithium	7	33	Beryllium	9	0.015
Boron	10	660	Sodium	* 23	4900
Magnesium	* 25	24000	Aluminium	27	720
Silicon	28	350	Phosphorus	31	110000
Potassium	39	2400	Calcium	44	19000
Scandium	45	1.3	Titanium	49	33
Vanadium	* 51	< 0.002	Chromium	52	460
Manganese	* 55	9100	Iron	57	24000
Cobalt	59	3.7	Nickel	60	140
Copper	63	990	Zinc	* 67	23000
Gallium	71	1.3	Germanium	74	< 0.058
Arsenic	* 75	2.7	Bromine	79	< 0.810
Selenium	78	1.1	Rubidium	85	1.3
Strontium	88	29	Yttrium	89	0.250
Zirconium	90	2.3	Niobium	93	0.490
Molybdenum	98	490	Ruthenium	102	0.037
Rhodium	103	0.200	Silver	107	0.730
Palladium	105	0.140	Cadmium	111	220
Indium	115	20	Tin	120	510
Antimony	121	52	Tellurium	126	0.190
Iodine	127	0.074	Caesium	133	0.075
Barium	138	99	Lanthanum	139	0.220
Cerium	140	0.480	Praseodymium	141	0.064
Neodymium	146	0.270	Samarium	149	0.038
Europium	151	0.069	Gadolinium	160	0.052
Terbium	159	0.013	Dysprosium	163	0.046
Holmium	165	0.006	Erbium	166	0.051
Thulium	169	0.010	Ytterbium	172	0.058
Lutetium	175	int.std	Hafnium	178	0.073
Tantalum	181	0.007	Tungsten	184	0.380
Rhenium	185	< 0.003	Osmium	190	0.007
Iridium	193	0.004	Platinum	194	0.003
Gold	197	< 0.028	Mercury	200	0.093
Thallium	205	< 0.004	Lead	207	6100
Bismuth	209	1.8	Thorium	232	0.093
Uranium	238	0.240			

* = from nitric acid extraction
int.std = internal standard used

Analyst. D. Walters. Tyl.

142909r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 14, 1990

ICP-MS Analysis

Sample Identity : #12 run 3,4 ash
E.R.I. Reference : 1429a2

Total Element Concentrations [micrograms per gram (ppm)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7		44	Beryllium	9		0.018
Boron	10		2600	Sodium	* 23		2400
Magnesium	* 25		51000	Aluminium	* 27		1300
Silicon	28		1300	Phosphorus	31		150000
Potassium	39		1400	Calcium	44		45000
Scandium	45		3.8	Titanium	49		94
Vanadium	* 51		2.7	Chromium	52		250
Manganese	* 55		2300	Iron	57		12000
Cobalt	59		3.4	Nickel	60		68
Copper	63		2100	Zinc	* 67		42000
Gallium	71		0.880	Germanium	74	<	0.069
Arsenic	* 75		3.6	Bromine	79	<	0.970
Selenium	78		1.2	Rubidium	85		1.3
Strontium	88		98	Yttrium	89		0.530
Zirconium	90		2.3	Niobium	93		0.430
Molybdenum	98		340	Ruthenium	102		0.031
Rhodium	103		0.230	Silver	107		1.1
Palladium	105		0.360	Cadmium	111		56
Indium	115		13	Tin	120		190
Antimony	121		51	Tellurium	126		0.560
Iodine	127		0.089	Caesium	133		0.064
Barium	138		140	Lanthanum	139		0.810
Cerium	140		1.8	Praseodymium	141		0.270
Neodymium	146		1.1	Samarium	149		0.240
Europium	151		0.170	Gadolinium	157		0.400
Terbium	159		0.031	Dysprosium	163		0.110
Holmium	165		0.019	Erbium	166		0.098
Thulium	169		0.014	Ytterbium	172		0.100
Lutetium	175		int.std	Hafnium	178		0.081
Tantalum	181		0.008	Tungsten	184		0.430
Rhenium	185		0.013	Osmium	190	<	0.003
Iridium	193	<	0.004	Platinum	194		0.029
Gold	197	<	0.034	Mercury	200		0.095
Thallium	203		0.5	Lead	207		7200
Bismuth	209		2.1	Thorium	232		0.370
Uranium	238		0.350				

* = from nitric acid extraction
int.std = internal standard used

Analyst. D. Lins. T.J.S.

142909r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 14, 1990

ICP-MS Analysis

Sample Identity : #13 run 5 ash
E.R.I. Reference : 1429a3

Total Element Concentrations [micrograms per gram (ppm)]

ELEMENT	MASS	CONC	ELEMENT	MASS	CONC
Lithium	7	42	Beryllium	9	0.023
Boron	10	480	Sodium	* 23	6800
Magnesium	* 25	36000	Aluminium	* 27	590
Silicon	28	420	Phosphorus	31	110000
Potassium	39	2200	Calcium	44	30000
Scandium	45	1.4	Titanium	49	4.1
Vanadium	* 51	< 0.002	Chromium	52	150
Manganese	* 55	2400	Iron	57	10000
Cobalt	59	4.3	Nickel	60	81
Copper	63	2300	Zinc	* 67	55000
Gallium	71	0.460	Germanium	74	< 0.061
Arsenic	* 75	100	Bromine	79	< 0.850
Selenium	78	1.7	Rubidium	85	1.7
Strontium	88	41	Yttrium	89	0.360
Zirconium	90	1.7	Niobium	93	0.170
Molybdenum	98	560	Ruthenium	102	0.035
Rhodium	103	0.120	Silver	107	2.0
Palladium	105	0.290	Cadmium	111	62
Indium	115	19	Tin	120	150
Antimony	121	59	Tellurium	128	0.220
Iodine	127	0.130	Caesium	133	0.077
Barium	138	150	Lanthanum	139	0.320
Cerium	140	0.680	Praseodymium	141	0.085
Neodymium	146	0.420	Samarium	149	0.042
Europium	151	0.140	Gadolinium	160	0.120
Terbium	159	0.016	Dysprosium	163	0.050
Holmium	165	0.015	Erbium	166	0.036
Thulium	169	0.004	Ytterbium	172	0.054
Lutetium	175	int.std	Hafnium	178	0.053
Tantalum	181	0.008	Tungsten	184	1.1
Rhenium	185	< 0.003	Osmium	190	< 0.003
Iridium	193	< 0.003	Platinum	194	< 0.006
Gold	197	< 0.030	Mercury	202	0.065
Thallium	203	0.270	Lead	* 208	9100
Bismuth	209	1.2	Thorium	232	0.140
Uranium	238	0.440			

* = from nitric acid extraction
int.std = internal standard used

Analyst. Darlene Taylor

142909r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 14, 1990

ICP-MS Analysis

Sample Identity : #14 run 6,7 ash
E.R.I. Reference : 1429a4

Total Element Concentrations [micrograms per gram (ppm)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7		71	Beryllium	9		0.034
Boron	10		1700	Sodium	* 23		2100
Magnesium	* 25		60000	Aluminium	27		460
Silicon	28		940	Phosphorus	31		140000
Potassium	39		2000	Calcium	44		57000
Scandium	45		2.8	Titanium	49		54
Vanadium	* 51		3.0	Chromium	52		250
Manganese	55		1300	Iron	57		14000
Cobalt	59		5.1	Nickel	60		63
Copper	63		3100	Zinc	67		32000
Gallium	71		0.980	Germanium	74	<	0.056
Arsenic	* 75		2.5	Bromine	79	<	0.770
Selenium	78		1.8	Rubidium	85		1.5
Strontium	88		84	Yttrium	89		0.600
Zirconium	90		1.1	Niobium	93		0.150
Molybdenum	98		520	Ruthenium	102		0.085
Rhodium	103		0.180	Silver	107		3.6
Palladium	105		0.360	Cadmium	111		49
Indium	115		7.8	Tin	120		230
Antimony	121		28	Tellurium	126		0.540
Iodine	127		0.087	Caesium	133		0.038
Barium	138		68	Lanthanum	139		0.400
Cerium	140		0.760	Praseodymium	141		0.140
Neodymium	146		0.500	Samarium	149		0.120
Europium	151		0.130	Gadolinium	160		0.180
Terbium	159		0.020	Dysprosium	163		0.120
Holmium	165		0.013	Erbium	166		0.070
Thulium	169		0.005	Ytterbium	172		0.075
Lutetium	175		int.std	Hafnium	178		0.049
Tantalum	181		0.015	Tungsten	184		0.730
Rhenium	185	<	0.003	Osmium	190		0.006
Iridium	193		0.005	Platinum	194		0.010
Gold	197	<	0.027	Mercury	202		0.016
Thallium	205		1.2	Lead	207		3200
Bismuth	209		0.800	Thorium	232		0.110
Uranium	238		0.410				

* = from nitric acid extraction
int.std = internal standard used

Analyst. D.A. Sine Tyl.

142909r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 14, 1990

ICP-MS Analysis

Sample Identity : #15 run 8 ash
E.R.I. Reference : 1429a5

Total Element Concentrations [micrograms per gram (ppm)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7		150	Beryllium	9		0.057
Boron	10		1400	Sodium	* 23		2900
Magnesium	* 25		50000	Aluminium	27		530
Silicon	28		1000	Phosphorus	31		150000
Potassium	39		3100	Calcium	44		52000
Scandium	45		3.0	Titanium	49		79
Vanadium	* 51		18	Chromium	52		240
Manganese	55		1600	Iron	57		15000
Cobalt	59		5.5	Nickel	60		81
Copper	63		3200	Zinc	* 67		39000
Gallium	71		0.980	Germanium	74	<	0.059
Arsenic	* 75		1.9	Bromine	79	<	0.830
Selenium	78		1.3	Rubidium	85		2.0
Strontium	88		85	Yttrium	89		0.450
Zirconium	90		1.6	Niobium	93		0.150
Molybdenum	98		300	Ruthenium	102		0.100
Rhodium	103		0.160	Silver	107		5.5
Palladium	105		0.340	Cadmium	111		77
Indium	115		2.9	Tin	120		230
Antimony	121		29	Tellurium	126		0.300
Iodine	127		0.067	Caesium	133		0.071
Barium	138		200	Lanthanum	139		0.360
Cerium	140		0.860	Praseodymium	141		0.130
Neodymium	146		0.580	Samarium	149		0.160
Europium	151		0.240	Gadolinium	157		0.330
Terbium	159		0.021	Dysprosium	163		0.052
Holmium	165		0.015	Erbium	166		0.086
Thulium	169		0.004	Ytterbium	172		0.022
Lutetium	175		int.std	Hafnium	178		0.067
Tantalum	181		0.012	Tungsten	184		0.250
Rhenium	185	<	0.003	Osmium	190		0.003
Iridium	193	<	0.003	Platinum	194		0.021
Gold	197	<	0.029	Mercury	200	<	0.013
Thallium	203		0.350	Lead	207		6200
Bismuth	209		1.0	Thorium	232		0.170
Uranium	238		0.380				

* = from nitric acid extraction
int.std = internal standard used

Analyst Darlene Tyr.

142909r

Elemental Research Inc.
309-267 West Esplanade
North Vancouver, B.C.
V7M 1A5, Canada

May 14, 1990

ICP-MS Analysis

Sample Identity : #16 run 9 ash
E.R.I. Reference : 1429a6

Total Element Concentrations [micrograms per gram (ppm)]

ELEMENT	MASS		CONC	ELEMENT	MASS		CONC
Lithium	7		48	Beryllium	9		0.022
Boron	10		790	Sodium	* 23		5900
Magnesium	* 25		38000	Aluminium	27		680
Silicon	28		420	Phosphorus	31		150000
Potassium	39		3300	Calcium	44		38000
Scandium	45		1.5	Titanium	49		160
Vanadium	* 51	<	0.002	Chromium	52		440
Manganese	55		1900	Iron	57		16000
Cobalt	59		11	Nickel	60		110
Copper	63		2800	Zinc	* 67		38000
Gallium	71		1.4	Germanium	74	<	0.056
Arsenic	* 75		4.8	Bromine	79	<	0.770
Selenium	78		2.2	Rubidium	85		1.9
Strontium	88		69	Yttrium	89		0.310
Zirconium	90		1.7	Niobium	93		0.300
Molybdenum	98		390	Ruthenium	101		0.061
Rhodium	103		0.240	Silver	107		2.3
Palladium	105		0.210	Cadmium	111		73
Indium	115		4.9	Tin	120		350
Antimony	121		98	Tellurium	126		0.360
Iodine	127		0.094	Caesium	133		0.096
Barium	138		220	Lanthanum	139		0.240
Cerium	140		0.590	Praseodymium	141		0.077
Neodymium	146		0.400	Samarium	149		0.038
Europium	151		0.210	Gadolinium	160		0.086
Terbium	159		0.020	Dysprosium	163		0.039
Holmium	165		0.010	Erbium	166		0.066
Thulium	169		0.009	Ytterbium	172		0.022
Lutetium	175		int.std	Hafnium	178		0.044
Tantalum	181		0.015	Tungsten	184		0.410
Rhenium	185	<	0.003	Osmium	190	<	0.002
Iridium	193		0.006	Platinum	194		0.012
Gold	197	<	0.027	Mercury	200		0.069
Thallium	205		4.9	Lead	* 208		12000
Bismuth	209		5.4	Thorium	232		0.080
Uranium	238		0.240				

* = from nitric acid extraction
int.std = internal standard used

Analyst. Darlene Taylor

142909r

file: YELKNIFE
27 Jun 90

JUNE 27, 1990.
PROJECT: 2-61-135

RE: ANALYSIS OF BENZENE, TOLUENE AND XYLENES ON NINE CHARCOAL SAMPLING TUBES.

GC CONDITIONS:

HP 5880 GAS CHROMATOGRAPH EQUIPPED WITH FID
COLUMN: 30M X 0.32mm DB-WAX
COLUMN PRESSURE: 85KPa HELIUM
COLUMN TEMPERATURE: 40 DEG.(3) TO 70 DEG. @5.0 DEG/MIN. TO 250 DEG. @ 15 DEG./MIN.

FID TEMPERATURE: 325 DEGREE
COOL ON COLUMN INJECTION TECHNIQUE

SAMPLE ANALYSIS

THE CHARCOAL IN THE FRONT AND BACK SECTION OF THE SAMPLING TUBE WAS TRANSFERRED INTO SEPARATE 4.0mL VIAL WITH TEFLON LINED CAP. CARBON DISULFIDE (2.0mL TO THE FRONT SECTION VIAL AND 1.0mL TO THE BACK SECTION VIAL) WAS ADDED AND THE SAMPLE WAS EXTRACTED IN AN ULTRASONIC BATH FOR 10 MINUTES. THE CS2 EXTRACT WAS ANALYSED FOR BENZENE, TOLUENE AND XYLENES USING THE GC CONDITIONS AS DESCRIBED ABOVE.

RESULTS

CONCENTRATIONS (ug.)

COMPONENTS	SAMPLE #1		SAMPLE #2		SAMPLE #3	
	Front	Back	Front	Back	Front	Back
METHYL ETHYL KETONE	14.6	<0.50	<0.50	<0.50	<0.50	<0.50
ACETONE	31.4	<0.50	<0.50	<0.50	<0.50	<0.50
BENZENE	30.9	<0.50	<0.50	<0.50	65.4	<0.50
TOLUENE	29.7	<0.50	18.0	<0.50	2.21	<0.50
ETHYLBENZENE	5.66	<0.50	<0.50	<0.50	<0.50	<0.50
P-XYLENE	5.75	<0.50	<0.50	<0.50	<0.50	<0.50
M-XYLENE	13.5	<0.50	0.94	<0.50	<0.50	<0.50
O-XYLENE	8.39	<0.50	0.46	<0.50	1.72	<0.50
CUMENE	0.94	<0.50	<0.50	<0.50	<0.50	<0.50

file: YELKNIFE
27 Jun 90

JUNE 27, 1990.
PROJECT: 2-61-135

RE: ANALYSIS OF BENZENE, TOLUENE AND XYLENES ON NINE CHARCOAL SAMPLING TUBES.

GC CONDITIONS:

HP 5880 GAS CHROMATOGRAPH EQUIPPED WITH FID
COLUMN: 30M X 0.32mm DB-WAX
COLUMN PRESSURE: 85KPa HELIUM
COLUMN TEMPERATURE: 40 DEG.(3) TO 70 DEG. @5.0 DEG/MIN. TO 250 DEG. @ 15 DEG./MIN.

FID TEMPERATURE: 325 DEGREE
COOL ON COLUMN INJECTION TECHNIQUE

SAMPLE ANALYSIS

THE CHARCOAL IN THE FRONT AND BACK SECTION OF THE SAMPLING TUBE WAS TRANSFERRED INTO SEPARATE 4.0mL VIAL WITH TEFLON LINED CAP. CARBON DISULFIDE (2.0mL TO THE FRONT SECTION VIAL AND 1.0mL TO THE BACK SECTION VIAL) WAS ADDED AND THE SAMPLE WAS EXTRACTED IN AN ULTRASONIC BATH FOR 10 MINUTES. THE CS2 EXTRACT WAS ANALYSED FOR BENZENE, TOLUENE AND XYLENES USING THE GC CONDITIONS AS DESCRIBED ABOVE.

RESULTS

CONCENTRATIONS (ug.)

COMPONENTS	SAMPLE #4		SAMPLE #5		SAMPLE #6	
	Front	Back	Front	Back	Front	Back
METHYL ETHYL KETONE	<0.50	<0.50	5.29	<0.50	<0.50	<0.50
ACETONE	<0.50	<0.50	7.23	<0.50	<0.50	<0.50
BENZENE	<0.50	<0.50	18.40	<0.50	<0.50	<0.50
TOLUENE	2.21	<0.50	17.9	<0.50	1.29	<0.50
ETHYLBENZENE	<0.50	<0.50	1.29	<0.50	<0.50	<0.50
P-XYLENE	<0.50	<0.50	0.71	<0.50	<0.50	<0.50
M-XYLENE	<0.50	<0.50	2.51	<0.50	<0.50	<0.50
O-XYLENE	0.62	<0.50	1.84	<0.50	<0.50	<0.50
CUMENE	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

file: YELKNIFE
27 Jun 90

JUNE 27, 1990.
PROJECT: Z-61-135

RE: ANALYSIS OF BENZENE, TOLUENE AND XYLENES ON NINE CHARCOAL SAMPLING TUBES.

GC CONDITIONS:

HP 5880 GAS CHROMATOGRAPH EQUIPPED WITH FID
COLUMN: 30M X 0.32mm DB-WAX
COLUMN PRESSURE: 85KPa HELIUM
COLUMN TEMPERATURE: 40 DEG.(3) TO 70 DEG. @5.0 DEG/MIN. TO 250 DEG. @ 15 DEG./MIN.

FID TEMPERATURE: 325 DEGREE
COOL ON COLUMN INJECTION TECHNIQUE

SAMPLE ANALYSIS

THE CHARCOAL IN THE FRONT AND BACK SECTION OF THE SAMPLING TUBE WAS TRANSFERRED INTO SEPARATE 4.0mL VIAL WITH TEFLON LINED CAP. CARBON DISULFIDE (2.0mL TO THE FRONT SECTION VIAL AND 1.0mL TO THE BACK SECTION VIAL) WAS ADDED AND THE SAMPLE WAS EXTRACTED IN AN ULTRASONIC BATH FOR 10 MINUTES. THE CS2 EXTRACT WAS ANALYSED FOR BENZENE, TOLUENE AND XYLENES USING THE GC CONDITIONS AS DESCRIBED ABOVE.

RESULTS

CONCENTRATIONS (ug.)

COMPONENTS	SAMPLE #7		SAMPLE #8		SAMPLE #9	
	Front	Back	Front	Back	Front	Back
METHYL ETHYL KETONE	<0.50	<0.50	<0.50	<0.50	114.	<0.50
ACETONE	<0.50	<0.50	<0.50	<0.50	6.53	<0.50
BENZENE	33.8	<0.50	<0.50	<0.50	12.1	<0.50
TOLUENE	20.7	<0.50	2.53	<0.50	78.1	<0.50
ETHYLBENZENE	1.29	<0.50	<0.50	<0.50	13.9	<0.50
P-XYLENE	0.81	<0.50	<0.50	<0.50	16.1	<0.50
M-XYLENE	1.96	<0.50	<0.50	<0.50	32.9	<0.50
O-XYLENE	3.93	<0.50	<0.50	<0.50	16.7	<0.50
CUMENE	<0.50	<0.50	<0.50	<0.50	1.14	<0.50

TO: MR. MERV AIKEN

FROM: ANNE MORRISON

RE: RESULTS OF PAHs ANALYSIS ON TWO ASH SAMPLES AND TWO OIL SAMPLES FROM YELLOWKNIFE AND HAY RIVER RECEIVED ON JUNE 1, 1990

COMPOUNDS	CONCENTRATIONS (ug/g)			
	YELLOWKNIFE ASH COMP.	YELLOWKNIFE OIL COMP.	HAY RIVER ASH COMP.	HAY RIVER OIL COMP.
NAPHTHALENE	<0.25	72.8	0.25	29.7
ACENAPHTYLENE	<0.25	<2.5	<0.25	<2.5
ACENAPHTHENE	<0.25	<2.5	<0.25	<2.5
FLUORENE	<0.25	<2.5	<0.25	<2.5
PHENANTHRENE	<0.25	14.9	0.26	17.6
ANTHRACENE	<0.25	2.71	<0.25	4.55
FLUORANTHENE	<0.25	<2.5	<0.25	<2.5
PYRENE	<0.25	<2.5	<0.25	<2.5
BENZO(a)ANTHRACENE	<0.25	<2.5	<0.25	<2.5
CHRYSENE	<0.25	<2.5	<0.25	<2.5
BENZO(b)FLUORANTHENE	<0.25	<2.5	<0.25	<2.5
BENZO(k)FLUORANTHENE	<0.25	<2.5	<0.25	4.17
BENZO(a)PYRENE	<0.25	<2.5	<0.25	<2.5
DIBENZO(a,h)ANTHRACENE	<0.25	<2.5	<0.25	<2.5
BENZO(g,h,i)PERYLENE	<0.25	<2.5	<0.25	<2.5
INDENO(1,2,3-cd)PYRENE	<0.25	<2.5	<0.25	<2.5
TOTAL	<4.0	90.3	0.51	56.0

CCME

Canadian Council of Ministers of the Environment

Le Conseil canadien des ministres de l'environnement

Operating and Emission Guidelines for Municipal Solid Waste Incinerators

Report CCME-TS/WM-TRE003
June 1989

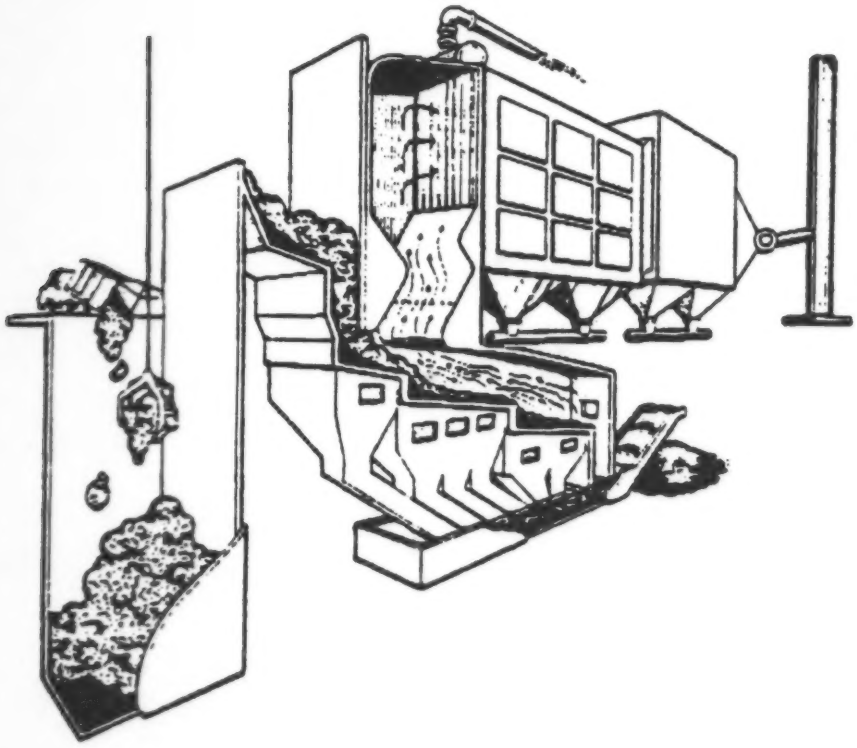

TABLE 4.2 STACK DISCHARGE LIMITS (at 11% oxygen)

Contaminant	Limit	Monitoring Method/ Averaging Time
Particulate Matter	20 mg/Rm^3	As specified by regulatory agency
Hydrogen Chloride (HCl)	75 mg/Rm^3* (50 ppmdv) or 90% Removal	Continuous Emission Monitor (24-hour Rolling Average)
Carbon Monoxide (CO)	57 mg/Rm^3** (50 ppmdv)	Continuous Emission Monitor (4-hour rolling average)
Total polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans	0.5 ng/Rm^3*** (Toxic Equivalency Factor new International Method, see Appendix B)	As specified by regulatory agency (3-test average)

* The least restrictive of these requirements apply.
** RDF systems should maintain a limit of 114 mg/Rm^3 (100 ppmdv).
*** Based upon isomer specific analytical test data; however, if only homologue test data are available, then the most conservative (largest) equivalency factor should be applied.

concentrations presented in Table 4.3. Systems burning normal MSW and in full compliance with the criteria presented in Table 4.2 should achieve the emission levels identified in Table 4.3.

Sulphur dioxide releases from MSW incinerators are highly variable because they reflect the sulphur content in the waste. Generally the sulphur content of MSW is low. Sulphur dioxide will react with the reagent used in the APC device. If hydrogen chloride is removed with 90% efficiency, data indicate that approximately 70% of the sulphur dioxide will also be removed. Test data suggest that typical 24-hour average concentrations will be approximately 260 mg/Rm^3 at 11% oxygen (100 ppmdv).

Since data on hydrogen fluoride concentrations are limited, no emission level has been predicted.

Concentrations of oxides of nitrogen are anticipated to be 400 mg/Rm^3 at 11% oxygen (210 ppmdv).

TABLE 4.3 ANTICIPATED EMISSIONS FROM MUNICIPAL SOLID WASTE INCINERATORS OPERATING UNDER GOOD COMBUSTION CONDITIONS AND EQUIPPED WITH DRY SCRUBBER FABRIC FILTER SYSTEMS (concentrations at 11% oxygen)

Contaminant	Typical Concentrations
Sulphur Dioxide	260 mg/Rm^3 (100 ppmdv)
Oxides of Nitrogen (NO_x as NO_2)	400 mg/Rm^3 (210 ppmdv)
Lead	50 µg/Rm^3
Cadmium	100 µg/Rm^3
Mercury	200 µg/Rm^3
Arsenic	1 µg/Rm^3
Chromium	10 µg/Rm^3
Polyaromatic Hydrocarbons	5 µg/Rm^3
Polychlorinated Biphenyls	1 µg/Rm^3
Chlorophenol	1 µg/Rm^3
Chlorobenzene	1 µg/Rm3

canadian microanalytical service ltd.

207 - 8116 ALEXANDER ROAD, RR #7, DELTA, B.C. V4G 1G7
FAX NO.: (604) 946-4447 PHONE (604) 946-4447

[redacted]
B.C. Research,
3650 Wesbrook Mall,
Vancouver, B.C.
V6S 2L2

Date:

P.O. #7817

Req. #R32256

RUSH SERVICE

Fax: 224-0540

Sample Number		Results (%)					
Yours	Ours	C	H	N	O	S	Others
n 1&2	S476					0.61	
n 3&4	S477					0.54	
n 5	S478					0.62	
n 6&7	S479						
n 8	S480					0.66	
n 9	S481					0.67	

emarks

Sample Run 6+7 (our S479) has very high sulphur content. Wemust repeat it and we will send you results today afternoon

Analyst: Pauline Maloney
Wieslawa Syrzycka

HALIDE ANALYSIS

Appendix : Fluoride, chloride and bromide concentrations in aqueous sample.

Sample Name	F^-	Cl^-	Br^-
	mg/L		
Yellowknife Blank	<0.2	<0.2	<0.5
BCR Blank	<0.2	<0.2	<0.5
Run 1	7.8	35.5	2.5
Run 2	7.9	57.0	4.9
Run 3	1.0	5.3	1.8
Run 4	0.4	11.5	0.9
Run 5	0.3	4.8	0.6
Run 6	<0.2	2.4	0.7
Run 7	<0.2	3.0	<0.5
Run 8	1.2	2.3	0.6
Run 9	1.2	22.6	<0.5